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Affordability of Defense Acquisition Programs

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This paper is identical to IDA Paper P-4961 of the same title, with the exception of four deleted figures designated "For Official Use Only." Those figures describe or illustrate aspects of the methodologies used by the Military Services in addressing affordability of acquisition programs. The figures are in no way essential to an understanding of this paper, or to its findings, conclusions, and recommendations.

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Executive Summary

Assuring the future affordability of acquisition programs in the Department of Defense (DOD) has been an enduring goal, which too frequently has not been achieved. The consequences are cancelling or curtailing programs that turn out to be unaffordable, with attendant waste. That has been true when total defense spending has been rising; it is a greater danger when total budgets are flat or declining.

A recent letter to new Secretary of Defense Chuck Hagel signed by five former Deputy Secretaries of Defense highlights the issue:¹

The hard choices should be made early. The federal budget outlook is not projected to improve for several years. So if a program or capability is not affordable now it is unlikely to be affordable going forward. Delaying hard choices means that resources will be spent on systems that will never be built and not be available at the right levels for the highest priority programs and capabilities.

An early initiative of the administration of President Barack H. Obama was to reform the defense acquisition process to reduce these chronic inefficiencies. In 2010 the DOD rolled out the Better Buying Power initiative to correct many well-documented problems with defense acquisition management. The initiative stresses affordability as its first area of focus.

The Director, Acquisition Resources and Analysis, in the office of the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) asked the Institute for Defense Analyses (IDA) to conduct a study of ways to establish an analytical framework that will inform decisions by DOD acquisition executives regarding affordability. In response to the request, this paper discusses methodologies, difficulties, and issues with regard to DOD's processes to ensure that its acquisition programs are affordable. Since the term *affordability* is used in several different ways with regard to the DOD acquisition program, it is useful to agree on a definition. This study proposes that: A program is *affordable* if it will be possible to execute and sustain the program as planned with the fiscal resources that will *likely* be available for it.

Affordability is more properly a characteristic of a *portfolio* of programs than of individual programs. The above proposed definition means that a program is affordable if it is contained within an affordable portfolio.

¹ Letter to Secretary of Defense Chuck Hagel, signed by John M. Deutch, John P. White, John J. Hamre, Rudy de Leon, and William J. Lynn III, Center for American Progress, March 5, 2013, <http://www.americanprogress.org/issues/ext/2013/03/05/57499/letter-to-the-honorable-chuck-hagel-secretary-of-defense/>.

The Better Buying Power initiative mandates affordability as a requirement, for both weapon systems acquisition and for operating and support (O&S) costs, starting at acquisition Milestone A (entry into Technology Development), to be treated the same as key performance parameters. This initiative is very similar to the Cost as an Independent Variable (CAIV) initiative of Under Secretary Paul Kaminski in the early 1990s and is less similar but related to the *design-to-cost* initiatives of the early 1970s. Both of those historical efforts to ensure affordable acquisition programs ultimately met with limited success.

Another point of view is that it is acceptable, even desirable, that outyear plans will contain more program content than can ultimately be afforded because not all the planned programs will in fact execute. For a number of reasons, some will be cancelled or delayed, freeing up fiscal room to fund the survivors. Unfortunately this strategy entails risks of significant waste from investing for too long in the programs that are eventually cancelled—a luxury that DOD can ill afford, especially in the current and projected fiscal environment.

The Defense Program Projection (DPP) is a fiscal projection of DOD forces, programs, and plans for twelve years beyond the current Future Years Defense Program (FYDP) that is performed episodically by the Office of Director, Cost Assessment and Program Evaluation (CAPE). The DPP is a particularly useful tool for assessing the affordability of DOD acquisition programs (since a portfolio's affordability cannot be reliably assessed if viewed strictly within the six-year FYDP period). (Appendix A provides a brief history of the DPP.)

The Congressional Budget Office (CBO) conducts a long-range projection of the DOD program much like the DPP. In addition to a baseline projection based on the DOD FYDP, CBO develops an alternative projection based on different assumptions, including most notably, an assumption of continuing growth in the cost of both DOD acquisition programs and operating and support costs (especially health care and military pay).

Both the DPP and the CBO outyear defense projections typically show a “bow wave” in investment costs in the years immediately beyond the FYDP. These bow waves are a warning to DOD acquisition executives facing decisions on both new starts and continuation of existing programs that the overall DOD investment program may not be affordable. Eliminating a bow wave entails, first, setting priorities. The following approaches can be employed to that end:

- Determine which areas of defense capability are most deficient in meeting projected national security requirements. Are programs causing the bow wave critical to addressing those deficiencies? What are the implications of cancelling or delaying lower priority programs? (A program-by-program assessment is necessary.)
- Determine what aging and/or obsolete equipment is most critical to replace. What alternatives are available to address those realities and at what cost and penalties vis-à-vis the new systems in the bow wave?

- To what extent could the cost of proposed programs in the bow wave be reduced by reducing performance or by use of alternative technologies or operating concepts?
- To what extent could the time-phasing of the programs comprising the bow wave be modified to smooth the outyear aggregate investment portfolio and make it more manageable? (See Chapter 8 for an illustrative analysis for Army modernization.)
- What changes in the national defense strategy could reduce the need for acquisitions in the bow wave? What risks would such changes entail and are they acceptable?

At the request of the sponsor, the study team investigated the approaches to affordability used by the Military Services. All Services at least recognized the need to deal with the problem; however the study team found considerable variation in both the approaches used and the level of maturity of the approaches. (Generally, it was found that the U.S. Navy and U.S. Air Force had more mature methodologies than the U.S. Army and U.S. Marine Corps.) The responsibility for addressing affordability within the Services tends to reside in the programming community; participation by the acquisition community varied considerably—more participation for the Air Force and less for the other Services.

The study team conducted an illustrative affordability assessment for the Army acquisition program. The Army was chosen for the assessment because the study team had more information on Army plans available to it from other IDA studies than for other Services.² The assessment found that:

- In the near years beyond the FDYP, the Army investment plans for fiscal years (FY) 2018–2024 exceeded the level of Army investment funding in FY2017 by an average of about \$1.8 billion (FY2013 dollars) or 7.5 percent, with the largest increase of \$3.5 billion projected for FY2020. This result incorporates the assumption that non-major defense acquisition program (MDAP) funding (for which the study team has no visibility) would be constant after FY2017.
- If that bow wave were accommodated by decreasing Army non-MDAP funding, the non-MDAP funding would suffer a 19 percent decline by FY2020.
- However, for the Army (and in fact all of DOD), both total operations and maintenance (O&M) and military personnel (MILPERS) costs have been growing at historical rates of about 1 to 2 percent per year per active duty military member from the early 1970s to today (exclusive of the cost of overseas contingency operations). If that growth continues with a constant active duty force structure and constant real defense topline, then at some point in the future investment funding will be forced to decrease. That would result in a considerably more pessimistic scenario than depicted above—if the Army MDAP programs are maintained, then non-MDAP Army investment would

² The study team constructed a representation of the Army investment program and plans through fiscal year 2030 using the best information available at the time. It may not accurately represent current Army plans.

decline by 50 percent from the FY2017 level by FY2020. And overall Army investment would decline by about 50 percent by FY2027. Such a drawdown is not without historical precedent, as demonstrated in Appendix C.

Over a number of years IDA has developed and refined a model called *Portfolio Optimization* (PortOpt). This model estimates the likely procurement costs of MDAPs under alternative production schedules, and optimizes those schedules simultaneously for multiple programs. The optimization is subject to annual budget constraints, minimum and maximum production rates, and endpoint deadlines for delivery of required quantities. The model was applied to the Army investment program (as described above) to determine whether an alternative schedule of investments could improve the overall affordability of the Army investment portfolio. The results were that rescheduling some of the MDAPs could result in an executable program under the funding ceiling of the FY2017 level of Army investment, with the penalty that total costs would increase by \$1.1 billion (FY2013) dollars. By a process of iteration, the model determined the minimum budget constraint for which a feasible schedule exists (i.e., achieves all deliveries by the end of the period). That minimum corresponded to the FY2014 level of total Army investment, at a cost increase in the MDAP programs of \$3.2 billion.

Conclusions

- Even though acquisition affordability has long been a concern for DOD and Congress (as evidenced by the CBO long-range projections for DOD), DOD still lacks coherent, disciplined processes for assessing affordability and making appropriate and timely adjustments to ensure a more affordable investment program. That is true both at the Office of the Secretary of Defense (OSD) level and at the DOD Component level.
- Affordability cannot be effectively addressed by the Defense and Component Acquisition Executives in the acquisition milestone review processes alone—it must also be addressed within the context of the overall DOD fiscal and force programs (i.e., the *Program Review* phase of the DOD planning, programming, and budgeting system (PPBS)). In the absence of that context, DOD acquisition executives cannot make well-informed decisions about affordability at acquisition milestone reviews. The Military Services apparently share this conclusion and have vested responsibility for affordability analyses within the Service programming communities.
- The Defense Program Projection is a valuable tool for DOD’s use in assessing affordability; however, in recent years it has seen only occasional, non-systematic use in that context. Its current time horizon of fourteen years beyond the budget year is too short for longer-range acquisition planning. The CBO longer-range DOD projection employs more sophisticated techniques for estimating the future growth in both acquisition and aggregate O&S costs than does the DPP.

- Models like IDA's PortOpt can be used to reduce peaks in the annual procurement funding required by a portfolio of programs by rescheduling production to take advantage of more efficient production rates. While such a rescheduling will likely result in some increases in individual program costs, and possibly in total cost to procure the portfolio, the overall affordability constraints might be preserved by optimizing the scheduling of production.
- O&S costs for acquisition programs are more difficult to estimate with accuracy than investment costs, and the processes for effective implementation of affordability caps for O&S costs are immature. An updated O&S costing guide for acquisition programs has been in draft form for a number of months, but is not yet published in final form.

Recommendations

- The DPP should be revitalized and reconfigured as an OSD-directed project that should be systematically updated after the submission of each President's Budget and with each Component submission of Program Objective Memoranda (POM). The time horizon should be extended to the budget year plus thirty years.
- The DPP and the analyses inherent in constructing it should be used in the Program Review process to assess the near- and long-term affordability of the overall DOD acquisition program (including requirements for future new programs) within the context of the total DOD program and projected funding availability. Such an assessment should be required in each Program Review. The Secretaries of the Military Departments and other DOD Component heads should ensure that similar processes are in place for their respective organizations.
- The Defense Acquisition Board should draw on the DPP and the latest affordability programmatic assessment at each milestone review for MDAP and pre-MDAP programs in order to have a context in which to assess the affordability of the program under review. Programs appearing to be unaffordable in that context *should not be approved*, pending an intensive review to determine the best alternative to restoring affordability in the overall DOD acquisition portfolio. Similar processes should be put in place for acquisition programs under Component management.
- The USD (AT&L) should encourage Director, CAPE to publish an updated guide for estimating the O&S costs for all weapons systems, including new starts. O&S cost estimates developed to support acquisition milestone reviews should be examined with the same rigor as investment costs.
- More research should be undertaken to develop better methods for determining and isolating those O&S cost elements that are largely determined by the design and support concepts of MDAPs in development, as opposed to those cost elements that are subject to change caused by external factors.

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1. Introduction

Assuring the future *affordability* of Department of Defense (DOD) acquisition programs has been an enduring goal, which too frequently has not been reached. An important recurring problem—caused by the frequent failure to adequately ascertain the affordability of new program proposals—has been the disruptive and costly turmoil throughout DOD’s acquisition *portfolio* that results whenever an ongoing program proves to be significantly more expensive than originally planned. This is true even when total defense spending has been rising; it is particularly true when total budgets are flat or declining.

In the words of five recent Deputy Secretaries of Defense, each of whom suffered through such problems:¹

The hard choices should be made early. The federal budget outlook is not projected to improve for several years. So if a program or capability is not affordable now, it is unlikely to be affordable going forward. Delaying hard choices means that resources will be spent on systems that will never be built and not be available at the right levels for the highest priority programs and capabilities.

There have been sporadic efforts over the years to require a sufficiently long view of likely resource availability and competing demands before making early decisions to start new acquisition programs. Unfortunately, the culture in the defense arena—both in the Pentagon and in Congress—has usually been sufficiently receptive to declarations of urgency by operational commanders and to promises by industry that “this time it’s different” for ambitious and complex new weapons concepts, that many such programs have been started that were ultimately determined to be unaffordable, at least on the schedule and in the numbers originally planned.

The administration of President Barack H. Obama has undertaken major efforts to reform the defense acquisition process to sharply reduce these chronic inefficiencies. The President has said “No more excuses, no more delays.”² In 2010 DOD rolled out the Better Buying Power (BBP) initiative³ of then-Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) Ashton Carter to correct many of the well-documented problems with defense

¹ Letter to Secretary of Defense Chuck Hagel, signed by John M. Deutch, John P. White, John J. Hamre, Rudy de Leon, and William J. Lynn III, Center for American Progress, March 5, 2013, <http://www.americanprogress.org/issues/ext/2013/03/05/57499/letter-to-the-honorable-chuck-hagel-secretary-of-defense/>.

² Deputy Secretary William Lynn III, “Real Acquisition Reform,” *Washington Times*, June 4, 2009.

³ Ashton B. Carter, “Memorandum for Acquisition Professionals Subject: Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending” (Washington, DC: U.S. Department of Defense, September 14, 2010).

acquisition management. The initiative stresses affordability as its first focus area (“Target Affordability and Control Cost Growth”), more specifically, mandating “affordability as a requirement” by setting “an affordability target to be directed by the program manager like a key performance parameter” at Defense Acquisition Milestone A (entry into the Technology Development phase of a new acquisition program) and requiring engineering trade studies that show how each key design feature affects costs at Defense Acquisition Milestone B (entry into the Engineering and Manufacturing Development phase).⁴

More recently, the USD(AT&L) has updated the earlier initiative with BBP 2.0.⁵ Again listing “Achieving Affordable Programs” as the number one initiative, the planned implementation was sharpened to include setting specific cost *caps* at Milestone A for both initial acquisition costs and for peacetime operating or *sustainment* costs. The basic concept is to ensure that all approved acquisition programs will fit within the total funding likely to be allocated to the modernization portfolio and associated sustainment budgets as currently projected through at least the ten years of the Budget Control Act of 2011.

Implementing DOD’s BBP affordability initiatives is forcing significant changes in its acquisition business practices. Implementation guidance is being prepared within the Office of the Secretary of Defense (OSD) but has not been issued as this paper was being prepared.

The Institute for Defense Analyses (IDA), as a Federally Funded Research and Development Center long and uniquely dedicated to supporting OSD with research on such matters, has considerable expertise in documenting and evaluating past attempts at acquisition reform. As a result, IDA was asked to examine and assess the ongoing efforts to improve attention to weapon system affordability throughout DOD—both with regard to initial acquisition costs and sustainment costs.

⁴ Carter, “Better Buying Power,” 2.

⁵ Frank Kendall, “Memorandum for Defense Acquisition Workforce, Subject: Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending” (Washington, DC: U.S. Department of Defense, November 13, 2012).

2. Affordability Considerations for Department of Defense (DOD) Acquisition Programs

A. Background on Affordability in DOD Acquisition

As noted in the Introduction, affordability is a term that has been the subject of much discussion over the past several years. In many cases these discussions have seemed to lack a full understanding of the term's meaning. Affordability relates to but is not the same thing as (1) cost-effectiveness, (2) prioritization, or (3) portfolio optimization.

For the purposes of this paper, affordability means that it will be possible to execute and sustain an acquisition program as planned with the fiscal resources that will *likely* be available for it. As the outbrief of the October 2012 Military Operations Society workshop on affordability stated: *"Affordability is not an inherent attribute of a program or requirement, but an informed judgment when compared to something else."*⁶

B. Macro or Programmatic Affordability—Priorities

Within the DOD budget of roughly half a trillion dollars, virtually any conceivable acquisition program (assuming it is technically feasible) can be executed if it is given sufficient funding priority. That is why affordability is so closely related to prioritization—almost representing two perspectives of the same underlying concept. But cost-effectiveness is also related to affordability since a program that is not cost-effective will not be able to successfully compete for the resources needed to execute it. A program may initially appear affordable, but if costs grow to a point where they appear to outweigh the benefits (i.e., effectiveness), *or* alternatively, if the original effectiveness objectives cannot be achieved or become less important to the Department of Defense because of changes to the national security environment (i.e., strategy changes), then the cost-effectiveness may decrease to a point where resource allocators are unwilling to devote the funds required to execute the program. In a sense, it becomes unaffordable. So when a particular program is declared "unaffordable," what is really meant is that the program is not (or is no longer) of sufficient priority to justify its cost.

Portfolio optimization means configuring a portfolio (i.e., which programs to fund and how much over time) based on some measure of merit. Defense acquisition portfolios are sufficiently

⁶ Greg Keethler et al., "Affordability Analysis: How Do We Do It?" (synthesis group outbrief, Military Operations Society (MORS) Workshop, Lockheed Martin Global Vision Center, Arlington, VA, 1–4 October 2012).

complex that it is usually not possible to define suitable quantitative measures of merit to do a meaningful mathematical optimization, at least not one that fully captures all facets of prioritization decisions. However, if such measures can be defined in a meaningful way, a mathematical optimization can certainly inform the decision-maker in setting priorities. If that cannot be done, then the decision-maker must set priorities by well-informed judgment supported by analysis.

Thus, in summary, while affordability is primarily a quality of a portfolio of programs, or of an entity's entire program,⁷ the term is frequently used in reference to an individual acquisition program in a way that relates to cost-effectiveness.

The concept of setting program affordability targets as a requirement is closely related to the concept of Cost as an Independent Variable (CAIV) that was introduced by USD(AT&L) Paul Kaminski in the early 1990s. The term CAIV was perhaps an unfortunate choice since it was not well understood by those outside the scientific or engineering community. In an experiment or design process, dependent variables are under the control of the experimenter or designer while the independent variables are the factors that are *not* under the experimenter or designer's control. In the traditional acquisition process, key performance parameters were the independent variables (specified outside the design process) while costs became a dependent variable. The cost was whatever was necessary to achieve the required performance, i.e., costs were driven by (or a function of) required performance. Recognizing that the traditional process drove cost growth in attempts to achieve ambitious performance objective, CAIV attempted to reverse that process (largely unsuccessfully). If the relevant cost to be assumed as the independent variable is program cost, then the CAIV approach, if successful, will result in affordable programs.

How does one maintain program cost as an independent variable? The usual approach is to modify performance parameters to keep costs within the desired limits; however, other approaches are possible, such as lengthening the schedule (i.e., proceeding at a slower pace in development or setting lower production rates). While these steps may increase total program costs and delay deliveries, they may also allow the program to execute within an annual cost constraint. (Another potential benefit is more time for technologies to mature and for more thorough testing that could ultimately be beneficial to users.)

C. An Alternative View of Affordability Constraints

While the concept of affordability described above makes sense logically, the intrusion of reality can lead to second thoughts. A valid argument against restricting the set of acquisition programs to only those that can clearly be executed within the perceived fiscal limits is that there are important parameters, including threats, technological progress, and budgets, that cannot be

⁷ For example, a Military Service or Department, or the DOD as a whole, or the entity's acquisition program portfolio.

accurately estimated years in advance. Some programs will succeed in achieving the desired capabilities in a cost-effective way while others likely will not. The unsuccessful programs may be cancelled, making fiscal room for the successful ones to continue, unless they are of overriding importance, in which case other more successful programs will likely be disrupted to stay within the overall fiscal limits. These outcomes are not predictable, so it may appear attractive to retain all of some larger set (portfolio) of programs, even though in aggregate it is in excess of the funding allocated to the portfolio, until the successful ones emerge and the others fall by the wayside.⁸

Another perspective on the same basic idea is that future required capabilities cannot be predicted with certainty. For example, it may be impossible to predict when or if a particular threat capability will materialize, or how future planning scenarios might evolve, rendering uncertain the best mix of U.S. force capabilities. This is much like maintaining multiple competitors in a development program with the understanding that eventually one winner will be chosen. This is a valid argument for retaining more programs in a portfolio or across portfolios than can ultimately be afforded; however, if that strategy is pursued, it must be done with careful weighing of the costs and risks to minimize the inevitable waste. In addition, the political implications of cancelling programs for which constituencies have developed must be dealt with.

D. Affordability Considerations within Specific Acquisition Programs

As discussed above, there is the portfolio view of affordability and the individual program view. This subsection will focus on the latter. The historical CAIV concept was previously mentioned as being similar in many ways to setting program affordability targets. Another related historical concept is design to cost (DTC), or sometimes stated more precisely as design to unit production cost. This concept took root in DOD in the early 1970s. DTC is thus one (but as noted not the only) approach to CAIV. Like CAIV, DTC met with limited success (for reasons beyond the scope of this study). Neither CAIV nor DTC focused on sustainment or total ownership costs.

As correctly emphasized in the BBP initiatives, engineering trade studies are the key to meeting affordability targets. Obviously a point could be reached where no acceptable tradeoffs will bring the program within the affordability target. In that case, the basic rationale for the program needs to be reexamined, and if it is still deemed of sufficient priority, additional resources will have to be devoted to its portfolio.

Another potential problem with an affordability target cost is that over time, it may be necessary to reduce the target. That would likely be the case if the planned allocation to the portfolio, as a whole or to the overall acquisition program, no longer appears likely to be available (which might be the case in the currently projected fiscal environment). Reducing the program's affordability target (if it is technically feasible to achieve a lower target) might be

⁸ This approach has been famously characterized by the maxim: "Kill no program until its time."

preferable to program cancellation, but needs to be done promptly and transparently (ways to effect such a reduction are discussed in Chapter 5).

3. The Defense Program Projection (DPP)

The DOD Planning, Programming, and Budgeting System (PPBS) maintains a fiscal plan, called the Future Years Defense Program (FYDP) that extends five years beyond the budget year. This plan projects funding for the major force programs planned to execute the nation's military strategy. It was long ago realized that a six-year horizon was inadequate to connect all current policy and programmatic choices to projected long-term objectives within resources projected to be available. First among these choices are decisions regarding new major weapon systems. In the early 1990s a project was initiated in OSD to extend the fiscal planning horizon for some number of years beyond the FYDP. That project later became known as the Defense Program Projection (DPP). The DPP has never been an official component of DOD's PPBS; in fact, after the first few years, the DPP has been completed episodically by Program Analysis and Evaluation (PA&E) and its Cost Assessment and Program Evaluation (CAPE) successor with little involvement of the OUSD(AT&L) or the Joint Staff.⁹ It is introduced here because of its potential value as a tool for assessing the affordability of future acquisition in the spirit of the Better Buying Power initiative.

A. Ground Rules, Assumptions, and Characteristics

It is important to understand the set of ground rules, assumptions, and characteristics CAPE analysts normally use to construct the DPP:

- The DPP is a projection beyond the FYDP of the programs and plans that are reflected in the FYDP; its purpose is to understand the longer-term implications of those programs and plans.
 - New starts that may be envisioned beyond the FYDP years, but that do not have precursors explicitly included in the FYDP, are not (normally) included in the DPP.
- It is not fiscally constrained beyond the FYDP.
- It includes all major acquisition programs (those for which firm, approved plans exist) and all major force programs; however, it is considerably less detailed than the FYDP.

⁹ As noted in Appendix A, which documents the early history of the Defense Program Projection (DPP), the Office of the Under Secretary of Defense (Acquisition, Technology and Logistics) (OUSD(AT&L)) and, to a lesser extent, the Joint Staff were involved in the original DPP projects in the late 1980s.

- It assumes that the funding allocated within the FYDP represents accurate estimates of the cost to execute the planned programs (however, the analyses performed to construct the DPP may cast doubt upon that assumption, and where that is the case, those issues are normally highlighted).
- Numerous smaller programs are included by rolling them up into what are called *remainder* lines which are projected via algorithms, so that all the financial entries add to a projected DOD topline.
- The length of time projected beyond the FYDP has varied over the years from twelve to eighteen years. The current projection is for fourteen years.
- A separate analysis of major equipment aging is also normally performed to assess whether currently approved acquisition plans will result in the timely replacement of aging equipment. (One or more excursions of the base case projection may be defined when it is found that existing plans pose a high risk to the timely replacement of aging equipment.)

B. Program Projection Model

A computer model has been developed by CAPE to assist in construction of the DPP. The model makes the calculations for remainder projections noted in the fifth bullet above. The projection algorithms utilize simple ratios of funding within the FYDP applied to aggregates of the entries that are projected by the analysts (e.g., major force structure and acquisition programs). (The documents in Appendix B outline the algorithms that are employed by the model.) The software also provides assistance to the analysts in formulating the projections and provides summary totals by a number of categories, such as by Military Service or DOD, mission category (using Defense Mission Category (DMC) codes), or budget appropriation categories (e.g., “Aircraft Procurement, Air Force” and “Other Procurement, Army”).

C. Aging Model

The DPP aging model maintains inventories and average ages of major equipment by type and by year historically and throughout the projection period. If newer equipment replaces older equipment at a sufficient rate, the fleet average age will decrease. However, if a new system’s procurement is at an inadequate rate or not soon enough to compensate for the aging of older equipment, the average age of the total inventory for the type of equipment will increase. If older equipment ends its useful life before it can be replaced, the inventory itself will go down. Figure 1 is an example of the display used by the DPP project (values shown are purely illustrative).

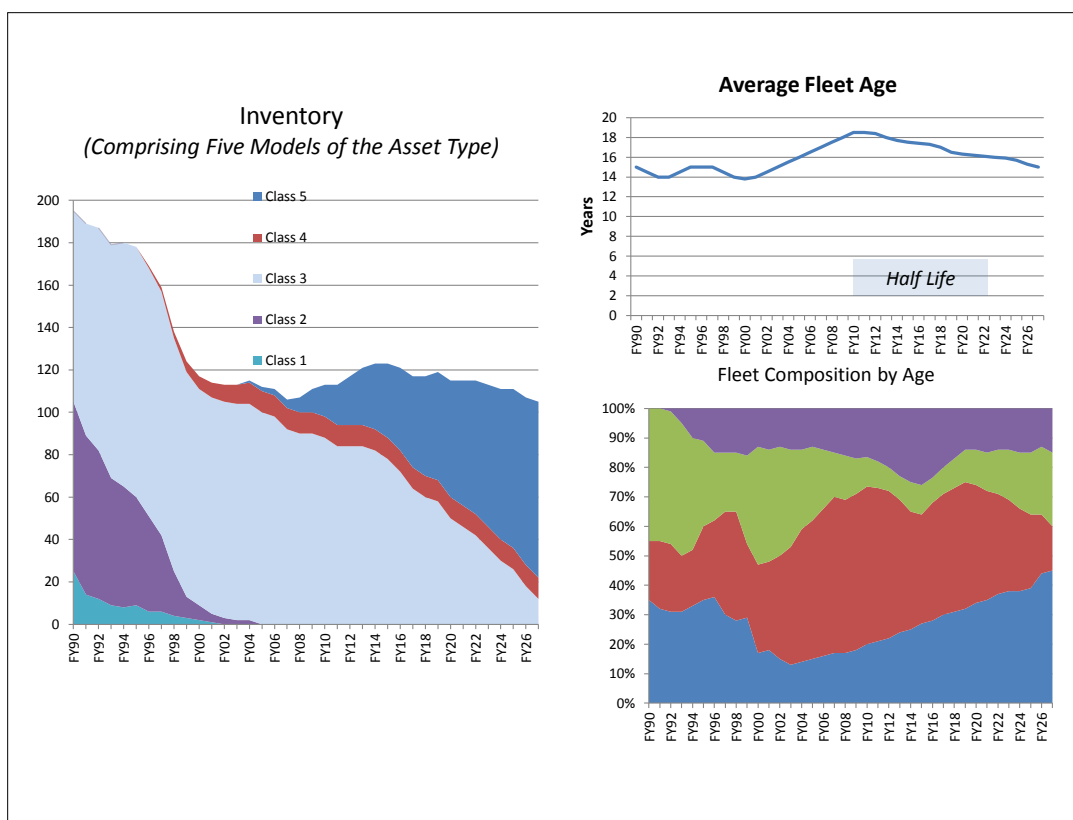


Figure 1. Illustrative DPP Aging Chart

Such analyses inform affordability assessments by indicating whether the quantities proposed for a new system that replaces existing inventory will be sufficient to maintain an acceptable aggregate average inventory age—i.e., will current plans allow DOD to be able to afford to buy enough of the proposed new system fast enough?

Also, a proposed new system will demand funds that could be used to replace other aging inventories (within the same portfolio). For example, a proposed costly new infantry fighting vehicle will consume funds that might otherwise be used to replace a large inventory of aging armored personnel carriers and support vehicles (in other words, an opportunity cost of the new system). By examining the age of all assets in the portfolio, the acquisition decision-maker can make a judgment as to whether the benefits of the proposed new system outweigh the benefits of replacing aging equipment (possibly in combination with a less costly alternative for the new system).

D. Limitations for Use of the DPP in Affordability Assessments

While it is useful in assessing the affordability of DOD acquisition programs, the DPP does have limitations that should be understood. The major ones are:

- The topline is unconstrained. This is the most obvious limitation for affordability assessments. Thus, the projection results must be viewed within the context of some

level of fiscal resources that DOD might reasonably expect beyond the FYDP. (Appendix C contains an analysis of the current environment for funding DOD major acquisition programs within both historical and future contexts.)

- The FYDP is assumed to execute as planned. Program delays and cost growth, which historically have frequently occurred in DOD acquisition programs, will have outyear implications that will affect other programs.
- The aggregated lines that contain numerous smaller programs, or even major programs such as special access programs that do not have visibility in the FYDP, are projected by a mathematical algorithm. Such “naïve” projections could be subject to a large margin of error in either direction.
- The DPP reflects only approved programs. While MDAPs that are beyond Milestone B have outyear plans (funding and procurement quantities) well documented in Selected Acquisition Reports (SAR), approved acquisition programs that have not passed Milestone B have less well-defined plans, especially those not yet passing Milestone A. And there may be Military Service plans for starting what will become major acquisition programs but which have not yet been brought to Joint Staff and OSD for approval.
- Inventory aging and obsolescence may occur at a different rate than anticipated, thus forcing changes to future acquisition plans to maintain key force structure.
- The operating costs of future weapons systems may not be accurately reflected in the DPP
 - Air Force aircraft and Navy ships and aircraft have explicit operating and support (O&S) costs in the FYDP. For these systems, O&S costs of a replacement system are reflected in the DPP; however, estimates of operating costs made during the development phase of a new system are subject to a large margin of error (new systems usually cost more to operate than the systems they replace, and more than estimated during development).
 - For ground forces (Army and Marine Corps), most O&S costs are rolled up into large-size unit costs, such as Army combat brigades or Marine Corps regiments. Normally the DPP does not attempt to reflect cost changes attributable to modernizing equipment in such units. For example, the Army plans to replace most Bradley Fighting Vehicles (BFV) in its heavy brigades with the new Ground Combat Vehicle (GCV) (which the Army has stated will cost 70 percent more to operate than the Bradley); yet the DPP does not project an increase in costs as GCVs are projected to replace Bradleys in the years beyond the FYDP.
 - The DPP algorithms for all costs, other than those explicitly represented as described above, use FYDP averages or end-points to project amounts into the

years beyond the FYDP. Thus, the algorithms will not reflect long-term historical growth trends in those costs.

4. Defense Program Long-Term Projections by the Congressional Budget Office

The Congressional Budget Office (CBO) annually publishes a review of the long-term implications of the current FYDP. The CBO's projection, which spans the FYDP and an additional thirteen years, differs from the DOD's DPP in several ways:

- In developing their projections, the CBO re-costs the FYDP to account for perceived underfunding in such areas as health care and military pay costs and growth in weapon systems acquisition cost based on historical trends.
- CBO develops two projections—the first accepts the DOD FYDP and other available cost data at face value; the second (referred to as the CBO alternative) is based on the CBO's re-costed FYDP and CBO's best estimate of *likely* DOD costs beyond the FYDP, consistent with historical trends.
 - The baseline outyear (beyond FYDP) projection starts from DOD's FYDP, whereas the alternative starts from CBO's estimate of the likely cost of the FYDP, which is normally higher.
 - The alternative projection incorporates CBO's estimates of pay and health care costs based on broad national cost trends, other O&S costs based on long-term DOD cost trends (as described above), and revised weapon systems acquisition (largely procurement) costs based on historical cost growth in DOD acquisition programs.
- CBO's projections beyond the FYDP are based on the information available to it, which is more limited than that available to those who construct the DPP. For example, CBO has data from SARs (which are released to Congress) for existing MDAPs but not for pre-Milestone B programs that will become MDAPs when they pass Milestone B.
- CBO projection of remainders uses more sophisticated algorithms than does the DPP—as noted above the DPP algorithms are based on simple ratios derived from the FDYP. The CBO, on the other hand, uses linear regressions based on historical funding data that go back many years. Thus the CBO projection incorporates the long-term growth trend in O&S costs in its future projection, whereas the DPP projection normally doesn't.

The most recent CBO projection¹⁰ (see Figure 2) covers fiscal years (FY) 2013–FY2030.

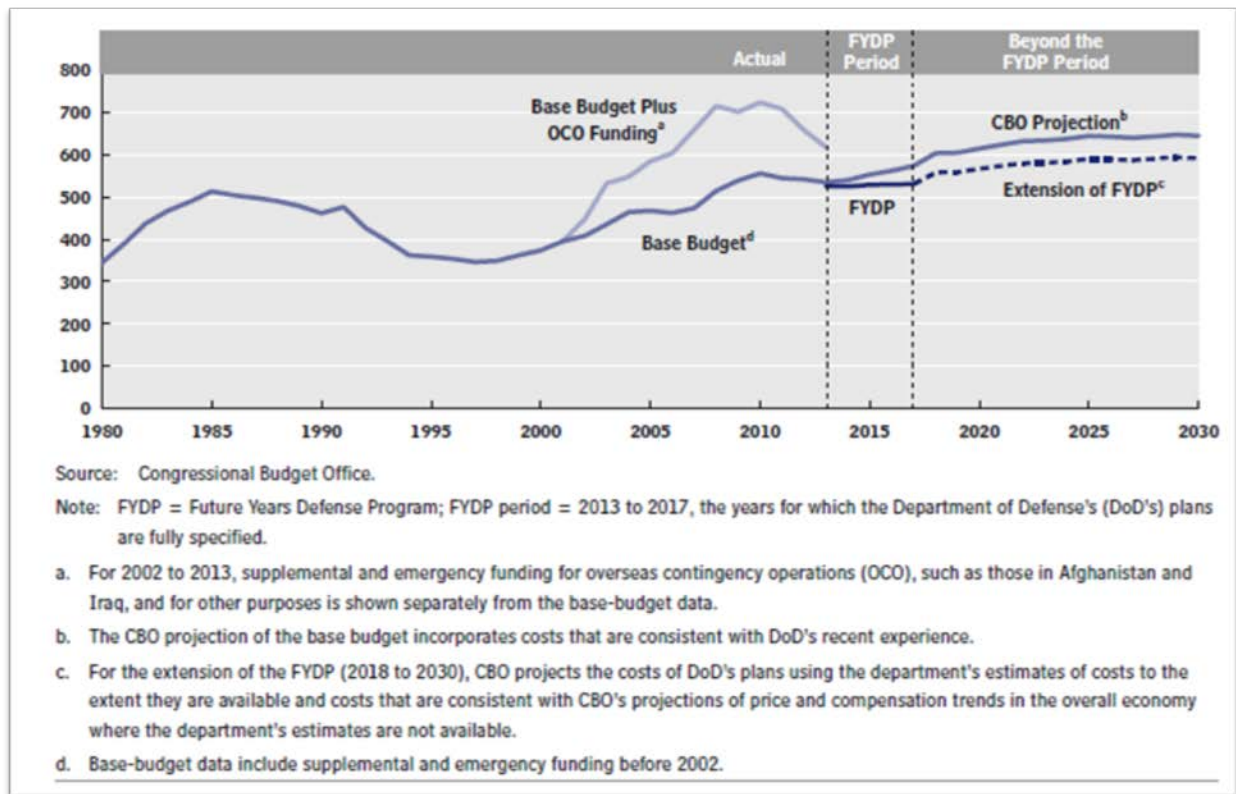


Figure 2. CBO Projection of DOD Program Costs

Its alternative projection costs exceeded the FYDP's by \$115 billion (4.4 percent) during FY2013–FY2017; the gap grows from 2 percent in FY2013 to 7 percent in FY2017 and reaches 9 percent in 2022.¹¹ The difference derives from CBO's judgment that historical trends in the costs of military health care, pay, weapon systems, and other support activities are likely to persist. CBO's projection of the base budget in 2013 also includes the personnel costs of 56,000 active duty Army and Marine Corps troops that DOD has funded in the overseas contingency operations (OCO) accounts.

Like DOD's projections, the most-recent CBO projection indicates a *bow wave* in investment accounts of about 10 percent over CBO's alternative projection of the FY2017 level of investment—somewhat higher than the DOD projection of about 6 percent. (The CBO alternative projection of investment funding for FY2017 is about \$16 billion over the FYDP.) This present study does not have available the data needed to determine the source of the differences between the CBO investment projection and the DOD projection.

¹⁰ Congressional Budget, Office (CBO), *Long-term Implications of the FY 2013–2017 Future Years Defense Program* (Washington, DC: CBO, July 2012).

¹¹ Over the CBO projection based on the DOD FYDP, not the DPP (to which CBO does not have access).

5. Bow Waves—Implications of Long-Term Investment Projections

Frequently, DPPs will indicate significant increases in required investment funding, especially procurement, in the years immediately beyond the FYDP and decreases in investment funding needs approaching the end of DPP projection period. The first phenomenon, known as an investment bow wave, occurs because MDAPs under development within the FYDP tend to reach full-scale production late in the FYDP or beyond it. (See Appendix A for an illustration of a previous MDAP bow wave.) The second phenomenon (a sharp decrease in investment funding in the far outyears) occurs because current programs complete, and not all emerging programs can be identified fourteen or more years in advance. Current projections show much the same trends, though differences among the Military Departments are significant.

How should DOD acquisition decision-makers deal with the beyond-FYDP bow wave problem? The modernization bow waves are strong indicators that the planned portfolio of investments is unaffordable in the aggregate. Consistent with the discussion in Section 2.C suggesting an alternative view of the affordability problem, an argument in favor of allowing the bow wave maintains that not all programs will succeed, and that the bow wave will shrink as time winnows out the failures. The challenge for the acquisition decision-maker supporting this approach is determining what degree of assuredness he or she has that such winnowing (which will be forced by the funds available) will constitute “creative destruction” and not simply wasted development funds as has occurred far too frequently in the past.

Another way to cope with an acquisition bow wave is to reduce production rates. This expedient, which normally increases the total cost of a program (assuming no change in production quantity) while reducing the funds needed in the short term (thus avoiding program cancellation), has been the practice all too frequently in the past. In addition to increasing total production costs, slowing down production will mean slower replacement of older equipment, which in turn may increase near-term maintenance costs if the cost of the older equipment is greater than the O&S cost of the replacement system.¹²

The bow wave has one major implication for affordability: at least some currently planned modernizations cannot be delivered on the planned schedules at the planned cost. This is not just because the DOD topline is likely to decline more than the current FYDP reflects, but also

¹² In most cases, new systems cost more to operate than the systems they replace, so even if an aging system’s maintenance costs go up, it still may remain below the cost of maintaining the new system.

because the procurement portfolio topline will probably decline even faster than the DOD topline because of the need to protect readiness funding in the face of the historical growth in O&S costs, unless force structure is also drawn down more than currently planned (which in any case only delays the problem until soon after force structure and active end-strength level off). This may impose additional operational risks (if, for example, the capability in question is needed to counter some new threat or to replace some expiring capability); and may deny or delay funding to some other important modernization effort.

There are a number of ways to address an investment bow wave problem. The first step (after *acknowledging* the problem and agreeing to address it) should be to prioritize the programs that dominate the bow wave. Setting priorities will need to take several diverse factors into consideration:

- Based on an analysis of the ability of the programmed force to meet the national defense strategy and objectives, which areas of defense capability are most deficient in meeting projected national security requirements? What are the implications of cancelling, delaying, or stretching lower priority programs (a program-by-program assessment is necessary)?
- What aging and/or obsolete equipment is most critical to replace? What alternatives are available to address those realities and at what cost and penalties vis-à-vis the new system in the bow wave (examples include Service-Life Extension Programs (SLEP) and upgrades for the existing inventory, new production of existing equipment types (possibly upgraded), foreign alternatives, or a combination of such approaches)?
- To what extent could the cost of proposed programs in the bow wave be reduced by reducing performance or by using alternative technologies in major system components?
- To what extent could the timing of the programs comprising the bow wave be modified to compress and stretch the bow wave to make it more manageable? (See Chapter 8 for an illustrative analysis for Army modernization.)
- If such steps do not eliminate the bow wave, it should be asked what changes in the national defense strategy might be considered that could reduce the need for acquisitions comprising the bow wave? What risks would such changes entail and are they acceptable?

An assessment along the suggested lines would lead to a set of alternatives to address the bow wave to be presented to DOD decision-makers. While some of these possibilities are within the purview of the USD(AT&L) and the Component Acquisition Executives (e.g., time-phasing production), most need to be addressed within the DOD strategy, planning, and programming communities, to include effective participation by the joint operational commanders. A Defense Acquisition Board (DAB) review for specific acquisition programs is *not* the appropriate forum

to address these issues in most instances. They must be addressed in processes comprising the DOD strategic planning and programming and budgeting systems.

6. Assessing Affordability in Acquisition Programs

As noted earlier, because affordability is a multi-faceted issue, it is not a characteristic for which analysis can provide a yes or no answer. Ultimately, it is a judgment that decision-makers (both acquisition and program/budget executives) must make. Analysis can, however, inform such judgments. It can also identify risk areas which could endanger a program's feasibility. This chapter will consider some analytical approaches that can help inform affordability assessments. Figure 3 summarizes several approaches to developing measures which will be discussed in this chapter.

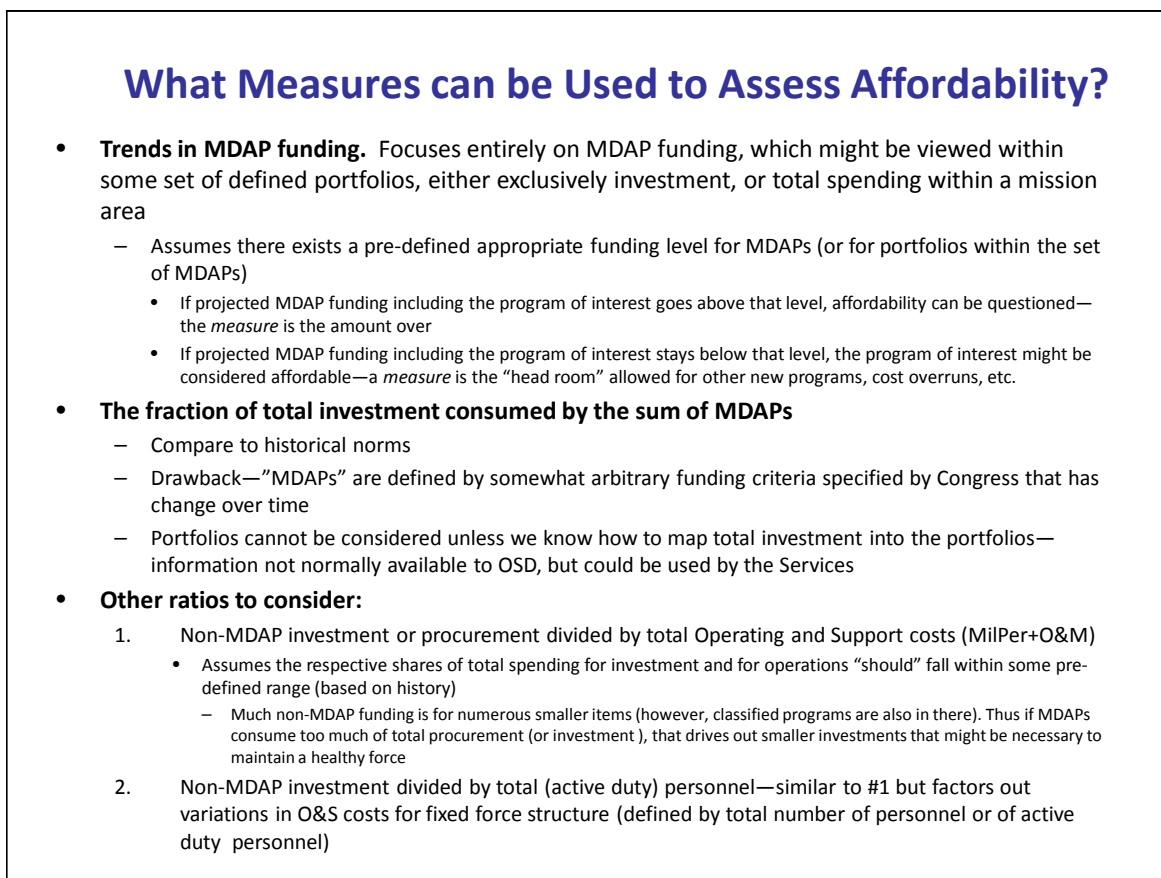


Figure 3. Analytical Measures Useful for Assessing Affordability

A. Trends in Major Defense Acquisition Program (MDAP) Funding

A program is first considered to be an MDAP after it has passed acquisition Milestone B and its planned acquisition funding totals meet criteria established by Congress. It is treated as a prospective MDAP, pre-MDAP, within DOD from its conceptual inception if it is estimated to eventually become an MDAP, but such programs are not formally reported to Congress until they pass Milestone B. While reasonable, the funding criteria to qualify for an MDAP are, nonetheless, arbitrary.

The first measure in Figure 3 is total MDAP spending, displayed in Figure 4. Use of this measure is based on the assumption that the sum of all DOD MDAP acquisition costs, or more typically those within a given Service, should remain within some fairly narrow bounds, for long periods either in absolute (inflation-adjusted) dollars or as a percentage of *total obligational authority* (TOA). Such an assumption has no particularly compelling analytical rationale. Nonetheless, this steady state measure has frequently been used in the past in OSD, mainly because it is easily derived. Data on MDAPs are readily available from SARs, which are required for all MDAPs and contain complete, detailed program plans and funding that are updated at least annually. This measure can be used in affordability assessments by examining whether there is room under the normal level of MDAP funding to fund a proposed program (viewed over time). While there is some rudimentary logic to that argument, it is a crude basis for assessing the affordability of a proposed program.

Aggregating planned MDAP funding at lower levels of indenture, such as within a DOD Component or within defined mission areas, is not useful for assessing affordability because, while total MDAP costs may be fairly stable at the DOD or Service level, mission area MDAP investments tend to be quite variable as small numbers of large programs wax and wane.

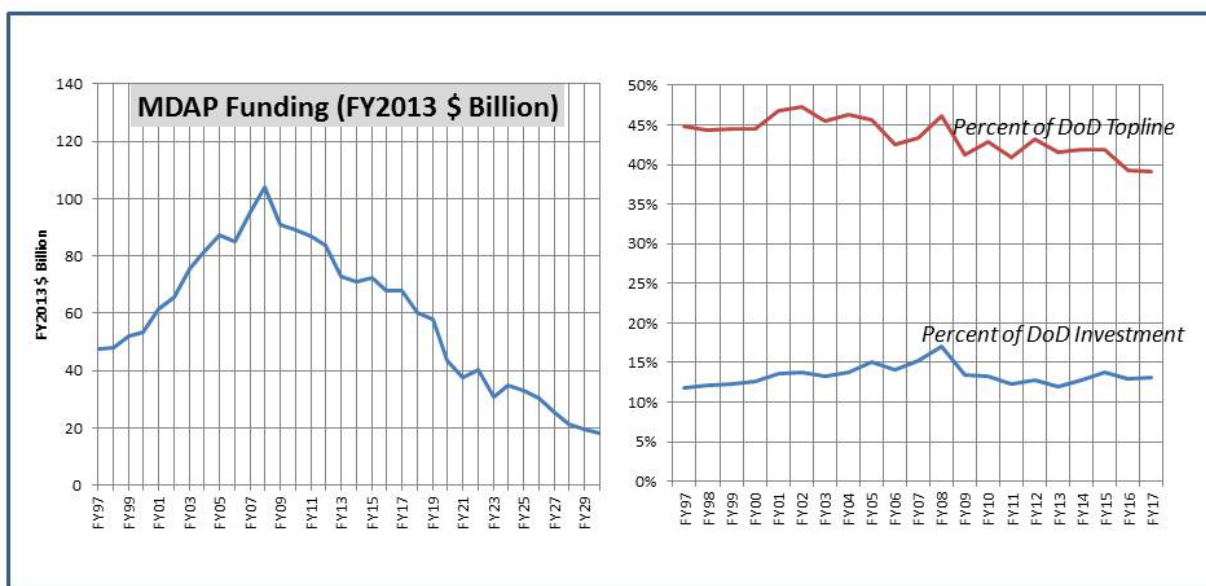


Figure 4. Historical and Projected Aggregate MDAP Funding and Percentages of DOD Topline and Total DOD Investment

Since MDAP funding naturally dies out in the far-outyears as existing programs mature and complete, there will always appear to be “headroom” for a new program if you go out far enough (see Figure 5). Even so, if a proposed new potential MDAP “consumes” most of the funds in the headroom, then if approved, there will be little room for other new starts that might also be needed but are not currently defined. That is, there would be no ability to add funding for programs designed to exploit a breakthrough technology by the United States (e.g., stealth in the 1980s), or by an adversary (e.g., cyber in the 2000s).

Figure 5 appears to offer plenty of room for new starts beyond the FYDP, but that depiction is quite misleading for two primary reasons:

1. It excludes programs that have been approved as new starts but have not yet passed Milestone B (for example, the Army’s GCV), and
2. It assumes that the FY2017 level of investment spending can be sustained through FY27.

There is good reason to question the second assumption. Appendix C contains an analysis of the funding likely to be available for investment in the outyears, based on historical DOD budget analyses. To delve more deeply into reason number 2 above, it is necessary to consider the budgetary environment more broadly than just the acquisition program, and that is the subject of the next section.

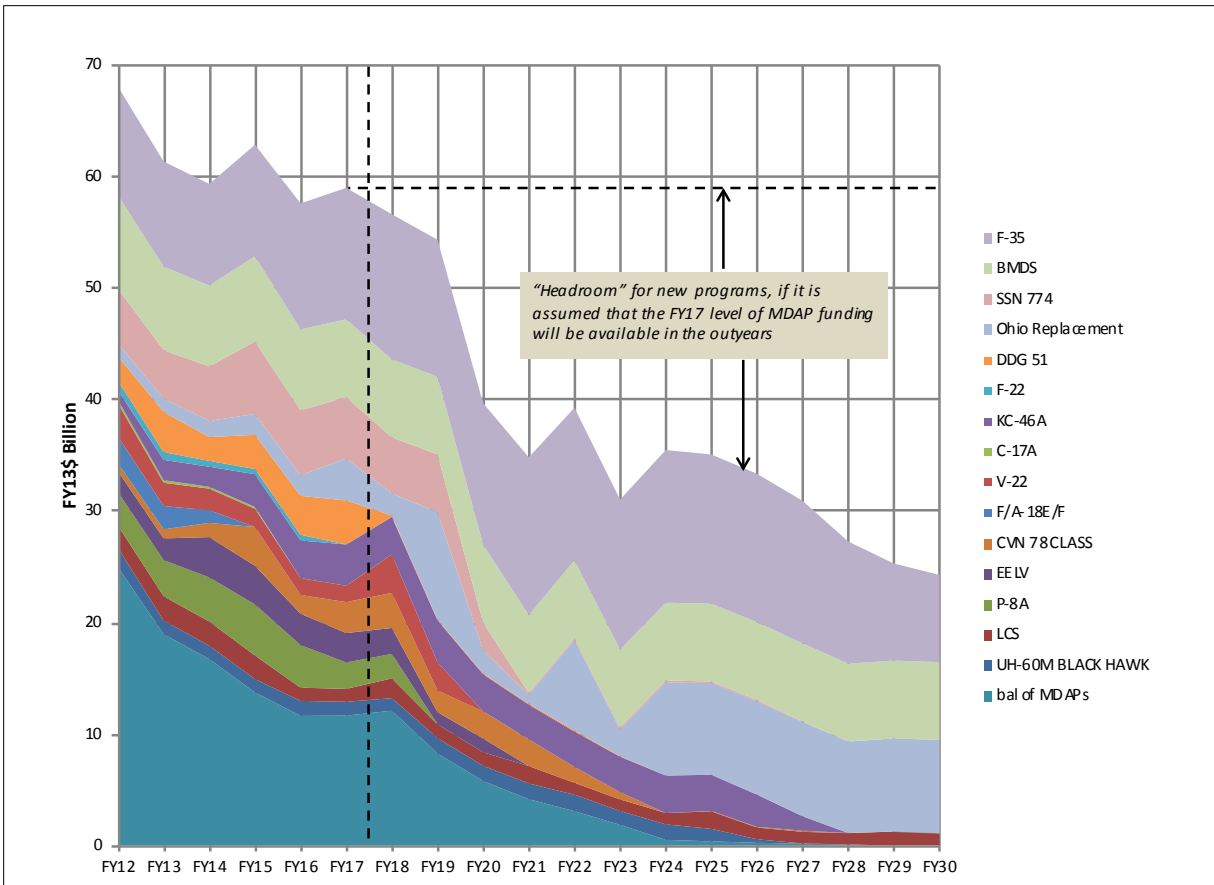


Figure 5. Current and Projected DOD MDAP Funding

Funding for MDAPs comprises only about 45 percent of total DOD investment funding. Adding the balance of investment funding to the graph in Figure 5 results in Figure 6, in which the non-MDAP portion of investment is projected for FY2018–FY2030 at the same level as FY2017. The headroom for new MDAPs is here shown within the context of the overall investment account—again assuming a flat investment topline beyond FY2017.

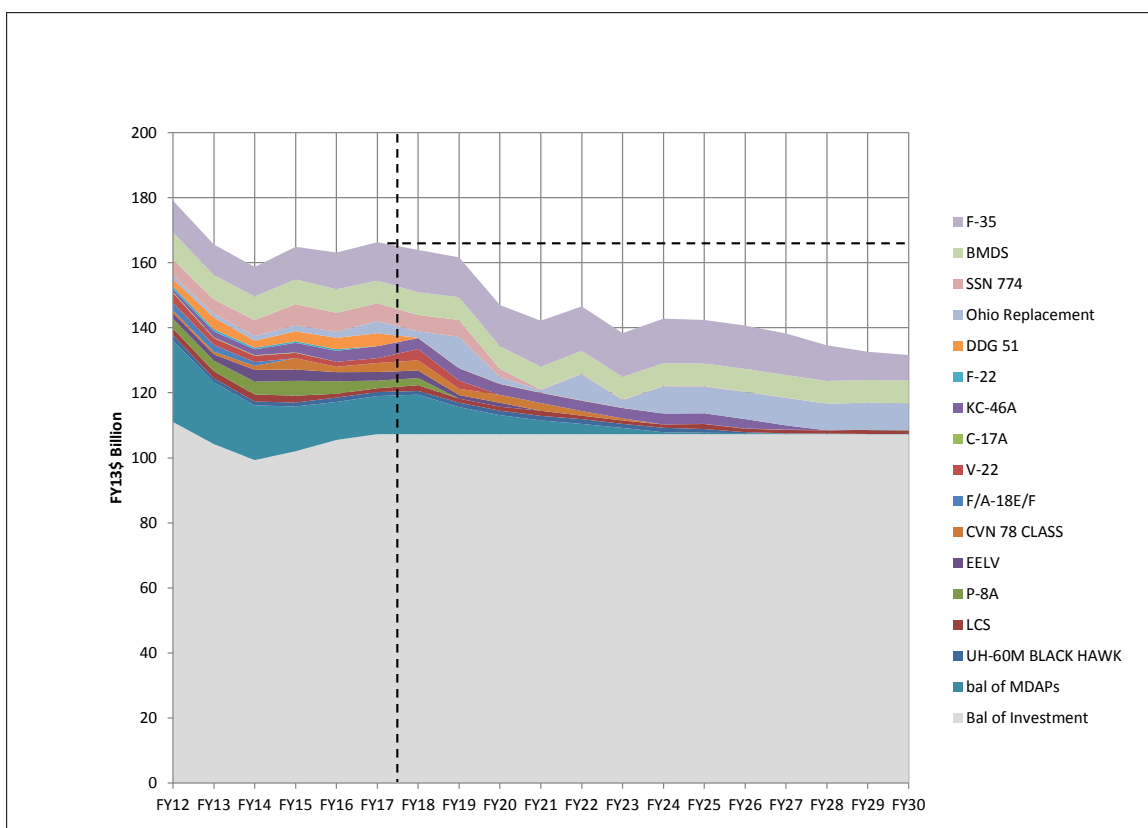


Figure 6. DOD Total Investment Funding Displaying MDAPs

B. The Relationships between Investment and Operating and Support Costs

Many well-informed observers of the current fiscal environment think it is very unlikely that DOD will see real increases in its level of TOA for the foreseeable future. However, even within a relatively constant level of TOA for DOD through FY2023 (as is directed by the Office of Management and Budget (OMB) and generally consistent with the Budget Control Act of 2011), the level of funding available to DOD for investment is likely to decrease. The reason is the inexorable historical growth in O&S costs to support a given force structure.

For this analysis, active duty military end-strength was used as a proxy for the DOD force structure.¹³ Figure 7 displays trends in total DOD operation and maintenance (O&M) and military personnel (MILPERS) funding from 1962 to projected FY2017. As seen, the historical growth rate in O&M per active duty military personnel (end-strength) has grown at a rate of almost 3 percent through FY2013, while MILPERS per active duty end-strength has grown at a

¹³ This a reasonable simplifying assumption even though it is possible to maintain the current force structure while reducing active duty end-strength. To do so would risk creating a hollow force, which this administration has pledged not to do. One could also effect active-to-reserve force conversions; however, arguably that would not maintain the current force since reserve forces in most instances do not have the same capabilities as active ones.

rate of 1.1 percent. That growth is projected to cease in the current FYDP.¹⁴ Once the war-related end-strength reductions are completed in FY2015, the growth in total O&S spending is likely to resume, absent any major changes in planned peacetime readiness goals.

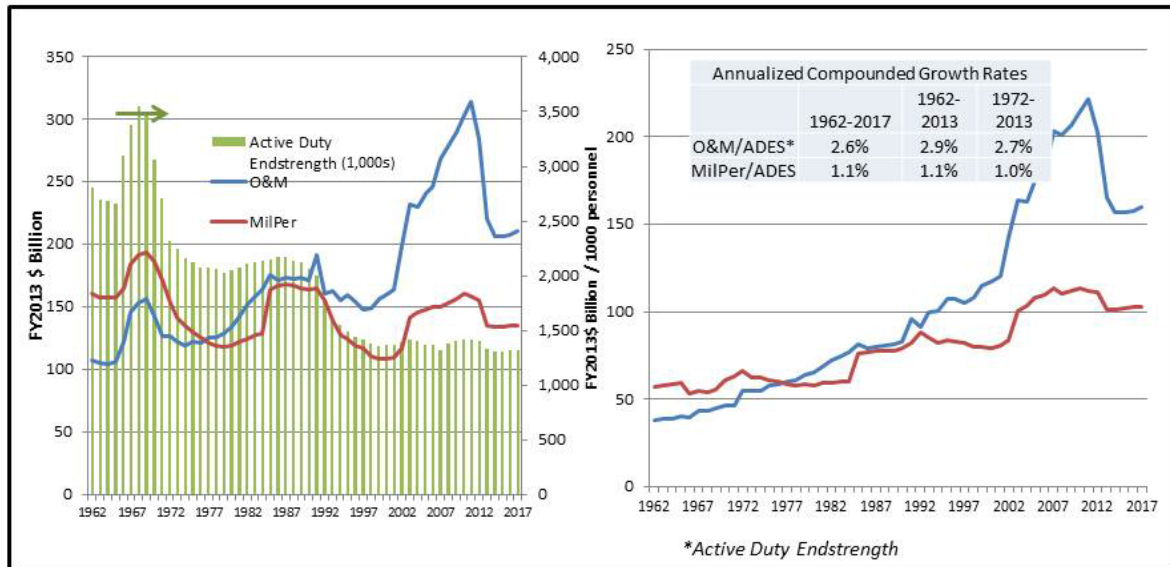


Figure 7. DOD Operating and Support Cost Trends

Thus, under an assumption of a constant active end-strength and constant topline, in real dollars, the inevitable result will be a reduction in funds available for acquisition, as shown in Figure 8. The downward sloping line in that Figure 8 illustrates the problem. The scenario would, of course, be unlikely to unfold as depicted in the figure—either the topline would increase or the active end-strength would decrease further (or both). Most observers might expect both topline and active end-strength to continue to decrease, which of course would eventually mean force structure declines to an untenable level. Ultimately the dynamics will be driven by the future national security environment and its political ramifications.

¹⁴ The FY2014 President's Budget was released while this paper was in final edit. The press release accompanying the budget announced initiatives in both health care and military pay, which, if approved by the Congress, should mitigate some future O&S cost growth. Whether they will succeed in reversing the long-term growth trends in these accounts is to be determined.

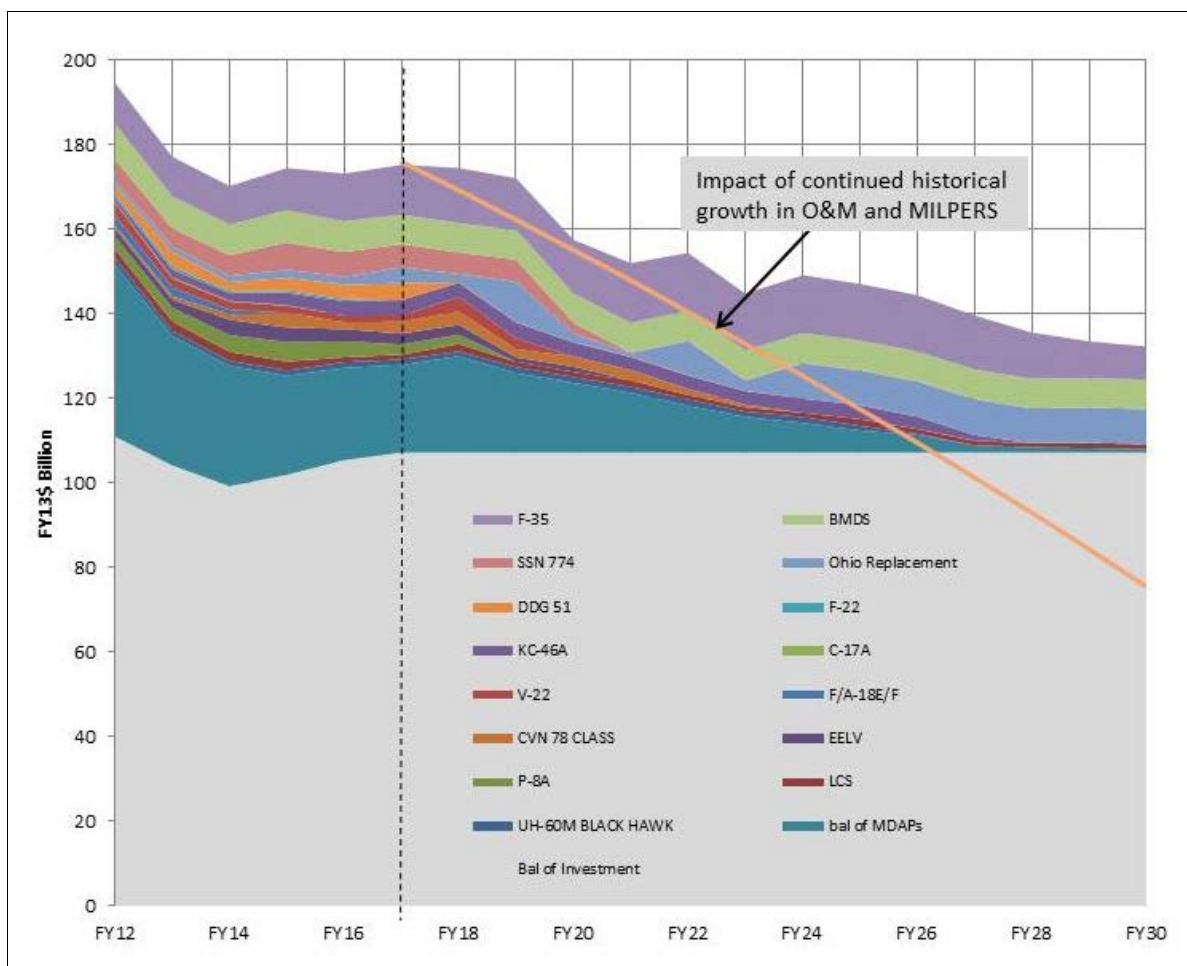


Figure 8. Illustrative Impact on Investment Funding of Continued Growth in O&S Costs

The failure of most DOD forward planning documents to adequately reflect the likely continuation of the historical growth in O&S costs creates a false sense of headroom that unless corrected will continue to result in excessively optimistic assessments of affordability.

If the scenario depicted in Figure 8 were to unfold, one outcome might be that the reduction would be taken entirely in non-MDAP investments, as illustrated in Figure 9. Since it is difficult to evaluate the numerous programs that comprise non-MDAP investments, the impact might be assessed indirectly by looking at historical ratios, such as the ratio of non-MDAP investment to aggregate O&S costs, as a proxy for the size and composition of the forces, which depend in many ways on those investments.¹⁵ A subsequent section of this paper considers that approach in an illustrative analysis of long-term investment affordability for the Army. (At the DOD level, there are simply too many complicating factors to make application of that ratio very

¹⁵ While no supporting data are immediately available, it is safe to say that the bulk of non-MDAP investment is needed to support the forces, either directly (trucks, electronics, etc.) or indirectly (e.g., strategic communications, intelligence, etc.). Thus to reduce those investments can be assumed to have an adverse impact, even if it cannot be quantified.

meaningful.) Figure 9 indicates that by FY2030 non-MDAP investment would decline to less than half of the FY 2017 level under the scenario depicted.

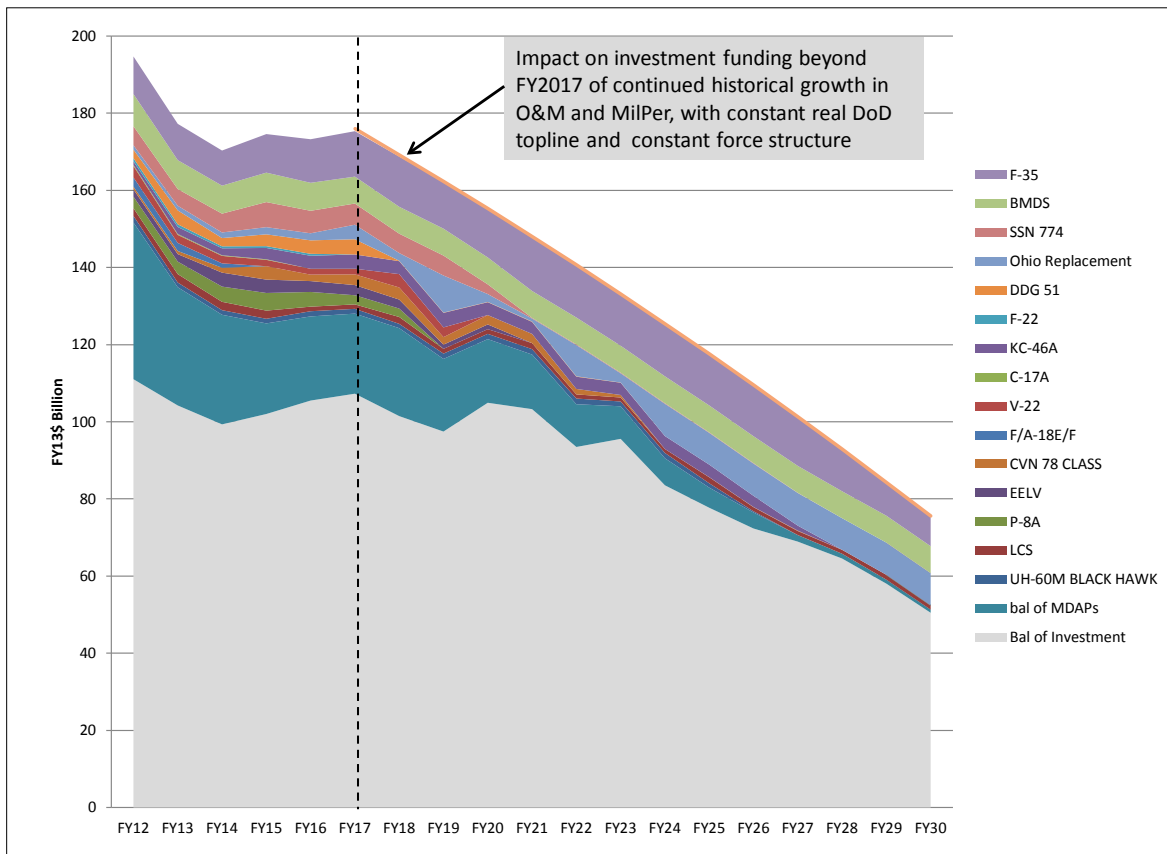


Figure 9. Investment Reduction Taken in Non-MDAP Investments

7. Approaches to Affordability Used by the Military Services

In contrast to the renewed interest in affordability in the acquisition community at the OSD level, which has been codified in the Defense Acquisition Executive's Better Buying Power initiatives, affordability in the Military Departments is addressed primarily in the program/budget preparation offices, not under the Service Acquisition Executives.

A. U.S. Army

The lead for production of the Army Program Objective Memorandum (POM) is the Army office of Program Analysis and Evaluation (PA&E), which resides in the Office of the Deputy Chief of Staff (G-8). Army PA&E establishes the share of total budget that will keep Army resource categories—from investment to base operations to manpower—in balance over time (Figure 10). The shares are derived from historical data for periods in which the Army believes it was in balance (e.g., not experiencing transients such as a “procurement holiday”). Given an assumed topline, these historical shares are used to project resources available in each category through approximately 2030. By fixing the topline at the level of the end of the current FYDP *in then-year dollars*, the Army constrains its long-term planning process to negative real growth. This constraint provides a small cushion against resource reductions in the future.¹⁶ It also creates some trade space for PA&E to adjust programs under the usual no-real-growth assumption.

¹⁶ This methodology has the disadvantage of having most of its impact in the far outyears beyond the FYDP, when resources tend to be plentiful as current programs complete. The impact on the years just beyond the FYDP, when resources appear to be tight, would be minimal under current inflation assumptions. (See Figure 20 in the Army illustrative affordability chapter.) It is also a rather arbitrary assumption since the impact depends on the inflation rates that are specified for DOD programming and budgeting.

Maintaining a Balance of Army Resources

Reductions to Army Funding must consider adjustments to manpower costs; otherwise Army would risk hollowing out the force

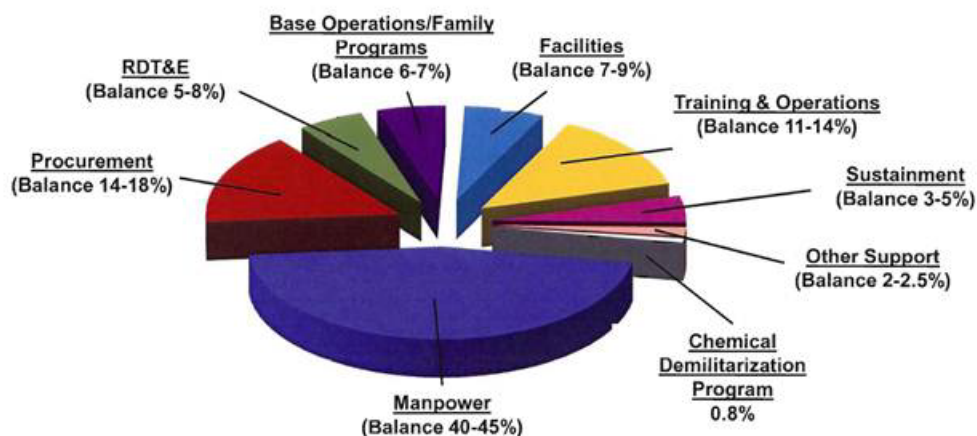
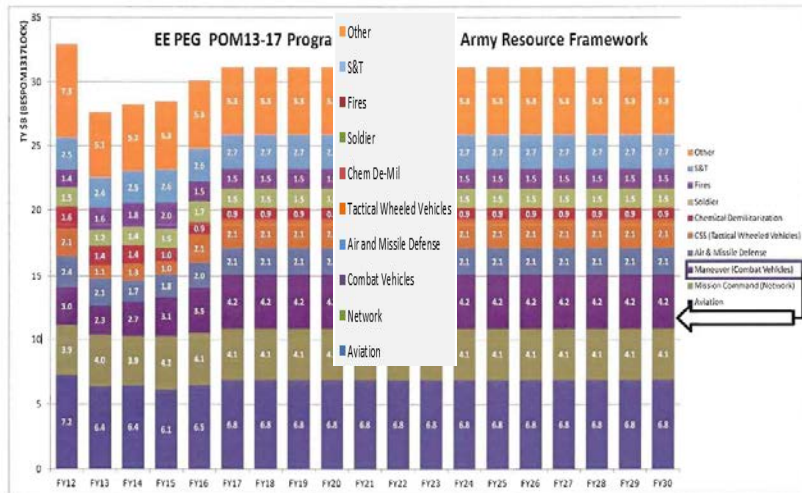


Chart obtained from Department of Army.

Figure 10. Army Approach to Investment Planning

For the investment portion of the Army's program projection, resources are further divided into major portfolios, such as science and technology, fires, and maneuver (Figure 11). These Army portfolios include functional categories, such as maneuver and mission command and "other," which includes soldier and science and technology; however, there appears to be some fluidity in the portfolio definitions. The portfolios are apportioned by fixed resources over time, again under the assumption of a constant projected investment budget in then-year dollars.

Portfolios as part of Total RDA Investment
RDT&E + Procurement across the Army



Assumptions:

- Investment Portfolio top-line growth is below inflation to better reflect future fiscal realities
- Major portfolios maintain relatively fixed funding levels
- Combat Vehicle Portfolio varies in accordance with the modernization projection
- Avg. Procurement Cost
 - GCV: \$12.9M
 - Abrams ECP: \$2M
 - Bradley ECP: \$1M
 - AMPV: \$4.5-6M

Resourcing the GCV program will require the Army to carefully balance modernization needs across the entire Investment Account

Chart obtained from Department of Army.

Figure 11. Army Investment Portfolios

These long-range projections inform programmatic reviews and decisions at several levels within the FYDP timeframe. The long-range projection is discussed at the four-star level at the beginning of the Army's programming cycle, in order to elicit senior leader guidance on Army priorities. For example, by choosing to minimize military construction or increase planned intervals for vehicle maintenance, the Army might be able to maintain force structure at desired levels. Such guidance would then be shared with the Program Evaluation Groups (PEG)—ranging from manpower to equipping to sustainment—which are then responsible for building a POM consistent with the guidance. The process might also be used to provide insights to top leadership on how much topline decrease the Army can absorb before having to take manpower cuts.

To illustrate the use of the Army long-range planning process in affordability assessments, Figure 12 portrays the Army's view of the affordability of its combat vehicle portfolio, prepared to support the GCV Milestone A and AMPV material development decision (MDD) reviews. Based on the portfolio analysis described above, the Army concluded that \$3.5–4.5 billion would be available annually for this portfolio throughout the period of consideration and that, using baseline plans and cost estimates, the projected modernization programs for combat vehicles

would be affordable. See Chapter 8 for a different view of the affordability of the Army's combat vehicles program.



Figure 12. Army Combat Vehicle Affordability Analysis (Redacted)

The Army does not appear to formally consider excursions to its long-range projections, nor does it explicitly consider the potential impact of historical cost growth in acquisition programs. However, the methodology permits the assessment of the consequences of some degree of topline uncertainty by employing the negative real growth assumption noted earlier.

It does not appear that the Army acquisition community participates in the long-range planning process to any significant extent.

B. U.S. Navy

The Navy POM process takes as its starting point the Secretary of Defense's Defense Planning Guidance and the related joint scenario development that takes place in the Analytic Agenda process. In that context, the Assessment Division (N-81) in the Office of the Chief of

Naval Operations (CNO) evaluates the projected capability of naval forces by conducting campaign analyses of the Navy's role in specific defense planning scenarios. N-81 is thus able to identify relative strengths and weaknesses among the naval capability areas needed to succeed in the scenarios. Those disparities are considered in a series of front-end assessments to move resources out of areas of strength to build up areas of weakness.

Insights from the front-end assessments yield a range of choices for the CNO's consideration and lead to the promulgation of the Navy's program guidance. N-81 devotes approximately \$90 million annually to conducting studies that will inform the development of the appropriate mix of Navy acquisition programs. The goal is to prevent the initiation of unaffordable or otherwise ill-conceived acquisition programs that are ultimately likely to be cancelled.

Key decisions about force structure begin with the demand signals contained in the Secretary's Guidance for the Employment of the Force (GEF), the Joint Strategic Capabilities Plan issued by the Chairman of the Joint Chiefs of Staff, and the Combatant Commanders' translation of those demands into their Theater Campaign Plans. The Department of the Navy sends teams to each Combatant Command (CCMD) to determine the implications of those plans for naval capabilities. N-81 then conducts a linear optimization analysis to determine the least-cost force structure mix that meets all such demand signals. The optimization ensures, first, that naval forces will be capable of meeting the demands of CCMD contingency operational plans, and second, that the CCMD's ongoing peacetime needs are addressed.

The N-81 utilizes a model in long-range resource planning similar to the DPP called the Extended Planning Annex Total Obligational Authority (EPATO) model (Figure 13).

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Figure 13. Navy Extended Planning Annex TOA Model Overview (Redacted)

The graph in Figure 14 presents the illustrative model outputs that project the Navy TOA required to support planned programs through FY2040. Figure 15 displays the projected tactical aircraft inventory through FY2040. The model also estimates requirements to replace aging inventories of ships and aircraft, and includes methodologies to estimate future O&S costs. The N-81 has been developing this model for a number of years. It appears to have significantly greater capability than OSD's DPP model;¹⁷ however, it is not clear from discussions with N-81 personnel the extent to which the model is actually used to support program and planning decisions.

The overall impression is that the Navy has a conceptually strong long-range resource planning process, though there is some question about the extent to which the insights of the process are actually used in making nearer-term resource decisions and the role of the Navy acquisition community in the process. Navy MDAP procurement schedules—mostly ships and

¹⁷ For example, the aging model is incorporated in the Extended Planning Annex Total Obligational Authority (EPATOA) whereas in the DPP process the aging model is separate. Also, the EPATOA may have a more detailed and accurate treatment of O&S costs than the DPP.

aircraft—are informed, if not constrained, by the N-81 affordability analyses, but the basic design concepts, unit cost projections, and acquisition program baselines are generally developed by the Navy acquisition community without explicit linkage to the N-81 affordability construct. Although the Navy has a long history of trying to pay attention to the total ownership costs of its new weapon systems, it is not apparent that the latest OSD emphasis on capping operating costs as well as acquisition costs has filtered down to the point of being reflected in recent Acquisition Decision Memoranda at and below the MDAP level.

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Figure 14. EPATOA Output—Projected Navy TOA (Redacted)



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Figure 15. EPATOA Output—Tactical Aircraft Inventory (Redacted)

C. U.S. Marine Corps

The U.S. Marine Corps (USMC) POM process is depicted in Figure 16. The Marine Corps divides responsibility for POM preparation between the Deputy Commandant, Programs and Resources (P&R) and the Deputy Commandant for Combat Development and Integration (CD&I). The former develops overarching financial requirements, policies, and programs. The latter is the resource sponsor and requirements developer for Marine Corps program portfolios, which are organized by warfighter function, such as fire and maneuver, command and control, and force protection.

- Service leads:
 - Deputy Commandant, Programs and Resources (P&R)
 - Deputy Commandant for Combat Development and Integration (CD&I)
- Assumption:
 - Considers “below zero real growth” and “zero real growth” cases
 - Historical apportionment of the budget informs expected affordability
 - O&M costs scale with platform acquisition costs
- Methodology:
 - P&R provides topline forecast
 - CD&I forecasts investment needs for each portfolio over 20 years using spreadsheet tools
- Usage:
 - Planners use forecasts to impose restrictions on prospective programs, such as prohibiting new starts.
 - Assistant Commandant, who chairs Marine Corps Requirements Oversight Council, uses forecast to inform requirements determination

Figure 16. USMC Long-Range Investment Planning Process

In preparing the Marine Corps portion of the Department of the Navy POM submission, the Commandant of the Marine Corps provides guidance to inform integrated program assessments. The Deputy Commandant, CD&I, chairs the Warfighting Investment Program Evaluation Board (WIPEB) during the resource allocation phase of POM preparation. Like the Army, the general approach is to provide a fixed level of funding to each PEB. The PEBs are expected to construct a balanced program consistent with OSD and the Commandant’s guidance within that level. The resulting product is forwarded to the Marine Requirements Oversight Council for review before submission to the Commandant for final approval.

D. U.S. Air Force

Figure 17 is an overview of the Air Force long-range planning process in affordability assessments.

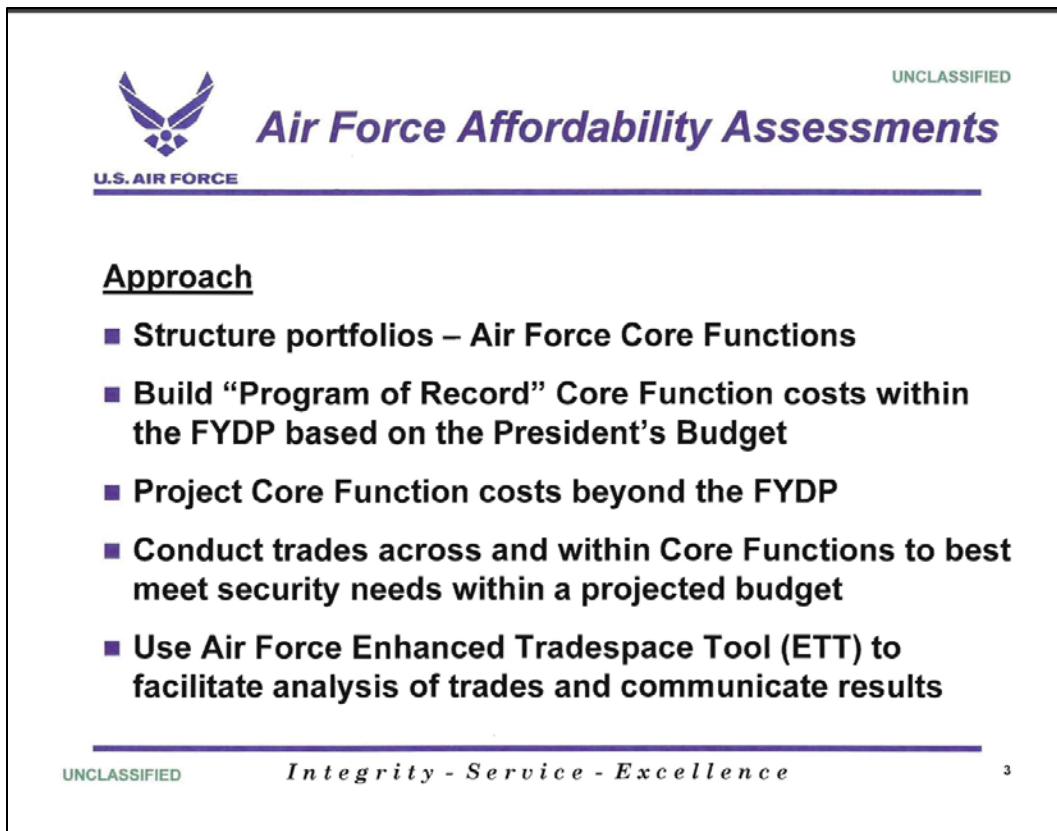


Illustration provided by the U.S. Air Force.

Figure 17. Overview of Air Force Long-Range Acquisition Planning Process

The Air Force long-range planning process is under the overall direction of the Deputy Chief of Staff for Strategic Plans and Programs (A8). The approach decentralizes the long-range planning function by designation of Core Function Lead Integrators (CFLI)—in essence portfolio managers—who propose long-range, resource-informed master plans for each of twelve Air Force Core Functions:

- Nuclear Deterrence Operations
- Air Superiority
- Space Superiority
- Cyberspace Superiority
- Global Precision Attack
- Rapid Global Mobility
- Special Operations
- Global Integrated ISR
- Command and Control
- Personnel Recovery
- Building Partnership
- Agile Combat Support

The goal of these master plans is to maintain needed capabilities within each core function over a time horizon of twenty-to-thirty years. Each CFLI master plan contains program profiles that collectively can be executed within caps derived from current fiscal guidance for the final

year of the FYDP as adjusted across portfolios by the Air Force analysis process. While the twelve plans collectively are constrained to the Air Force topline at the end the FDYP, resource levels vary within core functions from year to year. Figure 18 illustrates the projected funding as might be requested by each CFLI, and Figure 19 illustrates the results after the application of resource constraints.

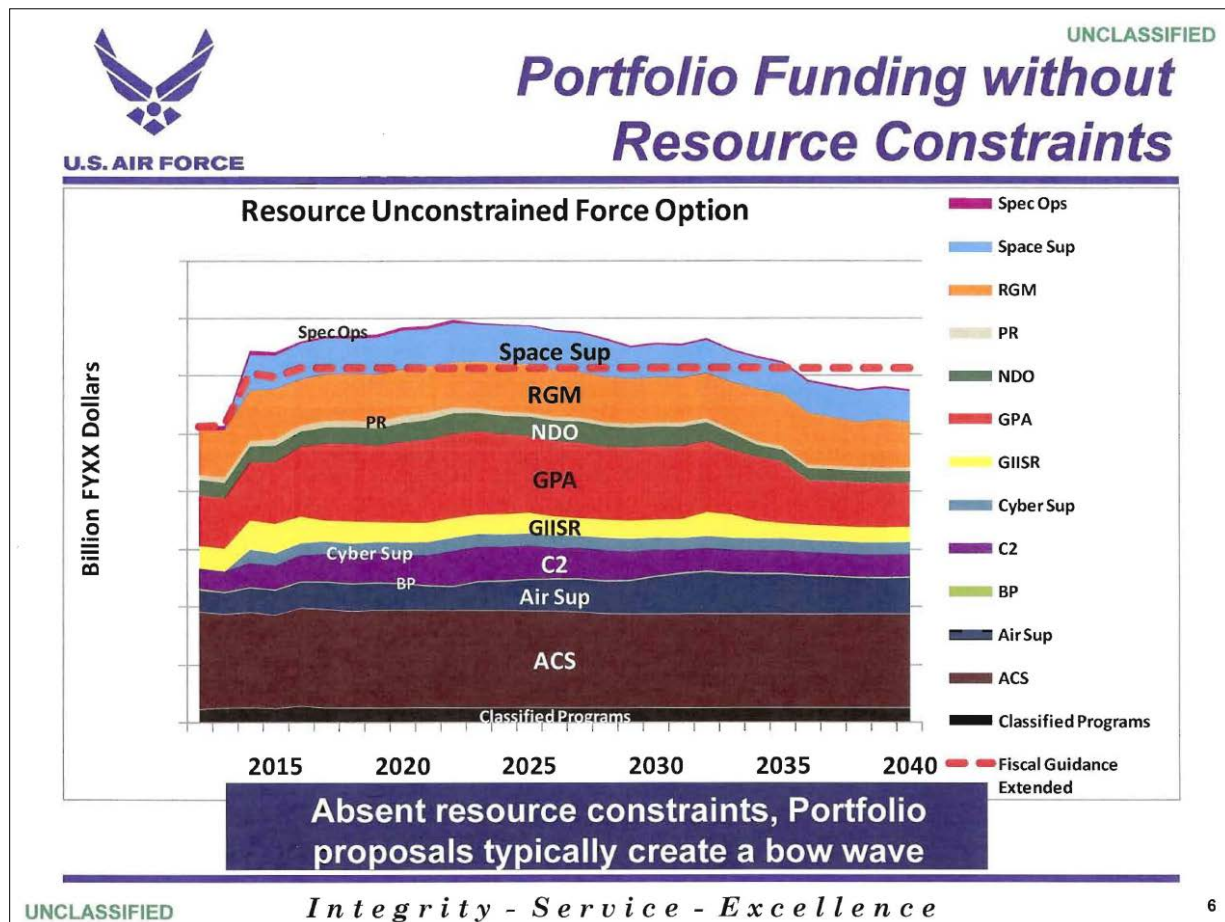


Figure 18. Air Force Long-Range Projection Before the Application of Funding Constraints

The constrained projection is developed using the Air Force's Enhanced Tradespace Tool (ETT), which considers both acquisition and O&S cost data in adjusting program plans and funding to ensure that total Air Force program funding stays within the prescribed allocation.

Data from the combined CFLI master plans feed back into the requirements community via the Air Force Requirements Oversight Council, chaired by the Vice Chief of Staff, which considers this information in determining the timing and desired capability of new acquisitions and upgrades. A8 also works with the Office of the Secretary of the Air Force for Acquisition (SAF/AQ) to develop the long-range acquisition program projections needed. In making these

resource allocation decisions, the Air Force leadership also considers other factors, such as the industrial base and the average fleet age.

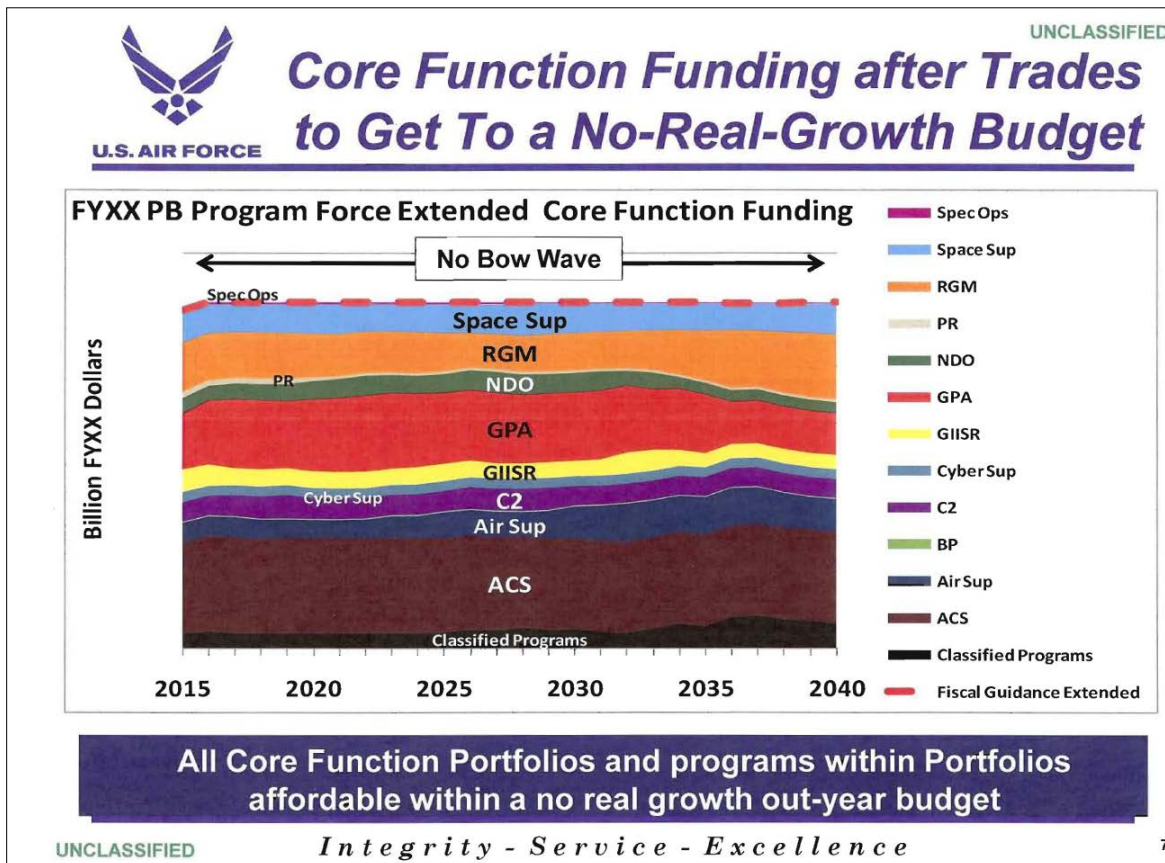


Figure 19. Air Force Long-Range Plan After Application of Funding Constraints

The CFLIs also influence POM development by providing recommendations to Headquarters, U.S. Air Force. However, overall POM development continues to be managed within the Air Staff. The Air Force's Vice Chief of Staff serves as the ultimate arbiter of the POM content in his role as chair of the Air Force Council.

The Air Force seems to have a reasonably well-developed and mature process for assuring that their total program is likely to meet overall fiscal targets. Nevertheless, the establishment and monitoring of program-specific acquisition and operating cost targets in response to the new BBP 2.0 mandate was not yet visible to the IDA study team.

8. Illustrative Affordability Assessments

This section develops the concepts discussed in earlier chapters into an illustrative acquisition affordability assessment for the Army. While its purpose is illustrative, the analysis uses “real data,” in the sense that the program plans reflect the study team’s estimates informed by several sources of data that were available to the team. Those sources include information from SARs from the Defense Acquisition Management Information System (DAMIR) database for the FY2013 POM submissions, briefings supporting milestone decisions, and Defense Program Projection data. Thus, it is believed that the data reflect with reasonable accuracy Army plans at the time the analysis was conducted; but not necessarily Army current plans. The assessment primarily focuses on investment (RDT&E and procurement); but, the impact of historical increases in O&S costs are also assessed. These data have the advantage of being relatively available to OSD, though they lack the currency and detail of Service-provided data. Therefore, they should be useful in providing preliminary insights on affordability, with the caution that a more detailed treatment is needed for any problem areas that they reveal.

An original objective of the study was to conduct similar assessments for Air Force and Navy programs; however, data to support such assessments were less readily available to the study team, and the study’s financial resource constraints limited further efforts to obtain and analyze such data. Nonetheless, this assessment can be used as a template for similar examinations of other Services’ programs.

A. Affordability of the Army Acquisition Program

Figure 20 is a representative projection of the Army acquisition program that the study team used as a baseline to assess acquisition affordability.

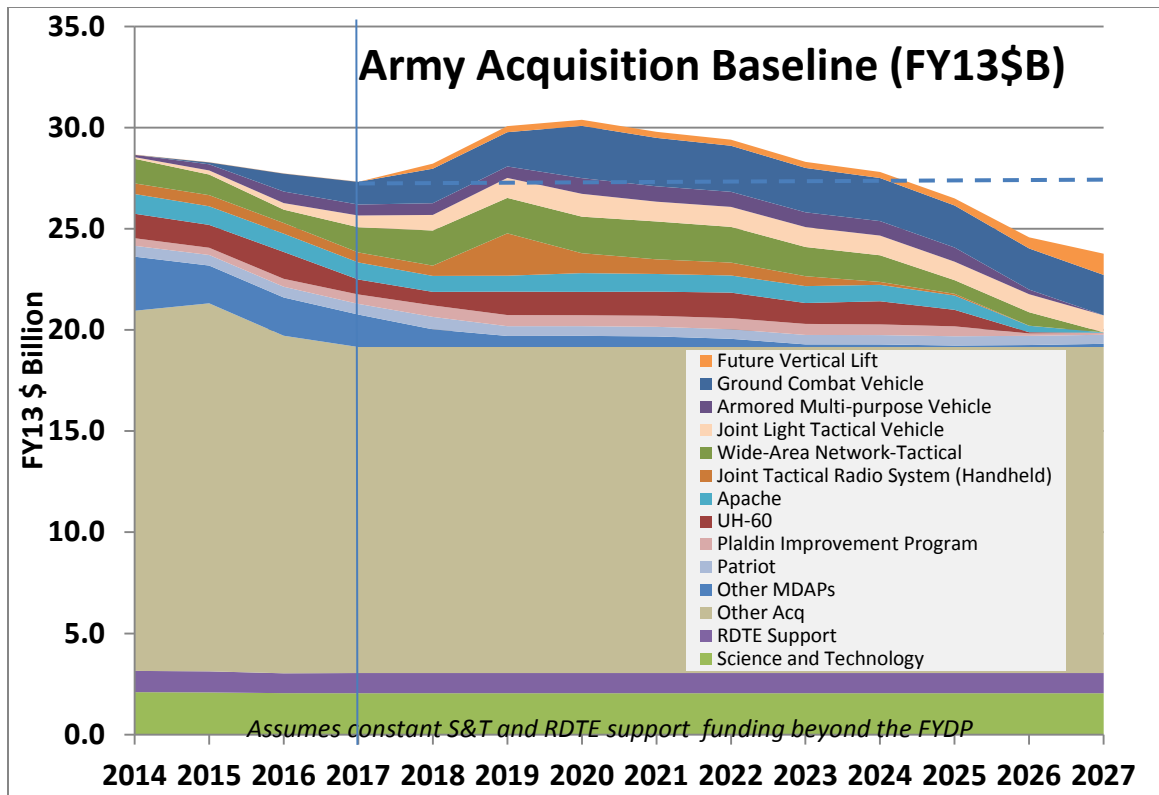


Figure 20. Baseline Projection for Army Affordability Assessment

The study team either obtained or constructed from available sources estimated planned funding for current MDAPs or likely future MDAPs for the FY2018–FY2027 period. (Funding data for FY2014–FY2017 are from the FY2013 President’s Budget.) The bottom three areas of the sand chart are aggregate funding lines that are all projected as *constant in FY2013 dollars* beyond the FYDP period. Under this projection, it can be seen that funding for Army acquisition would have to increase in the FY 2018–FY2024 period by between \$0.5 billion and \$3.1 billion per year, averaging \$1.8 billion per year, or 7.5 percent above the FY2017 level of funding for Army acquisition. In the current fiscal environment, such an increase is unlikely; in fact, it is unlikely that even the currently programmed FY2017 level of funding will be achieved (support for this assertion will be offered later in this section).

Another way to view this projection is to assume that the Army’s planned funding for MDAPs will execute as projected but that FY2018–FY2027 total funding for Army acquisition will remain at the FY2017 level. Under those assumptions (with the additional assumption that funding for Science and Technology and the RDTE support base will be constant), funding for the non-MDAP portion of Army investment will have to decrease. This scenario is displayed in Figure 21.

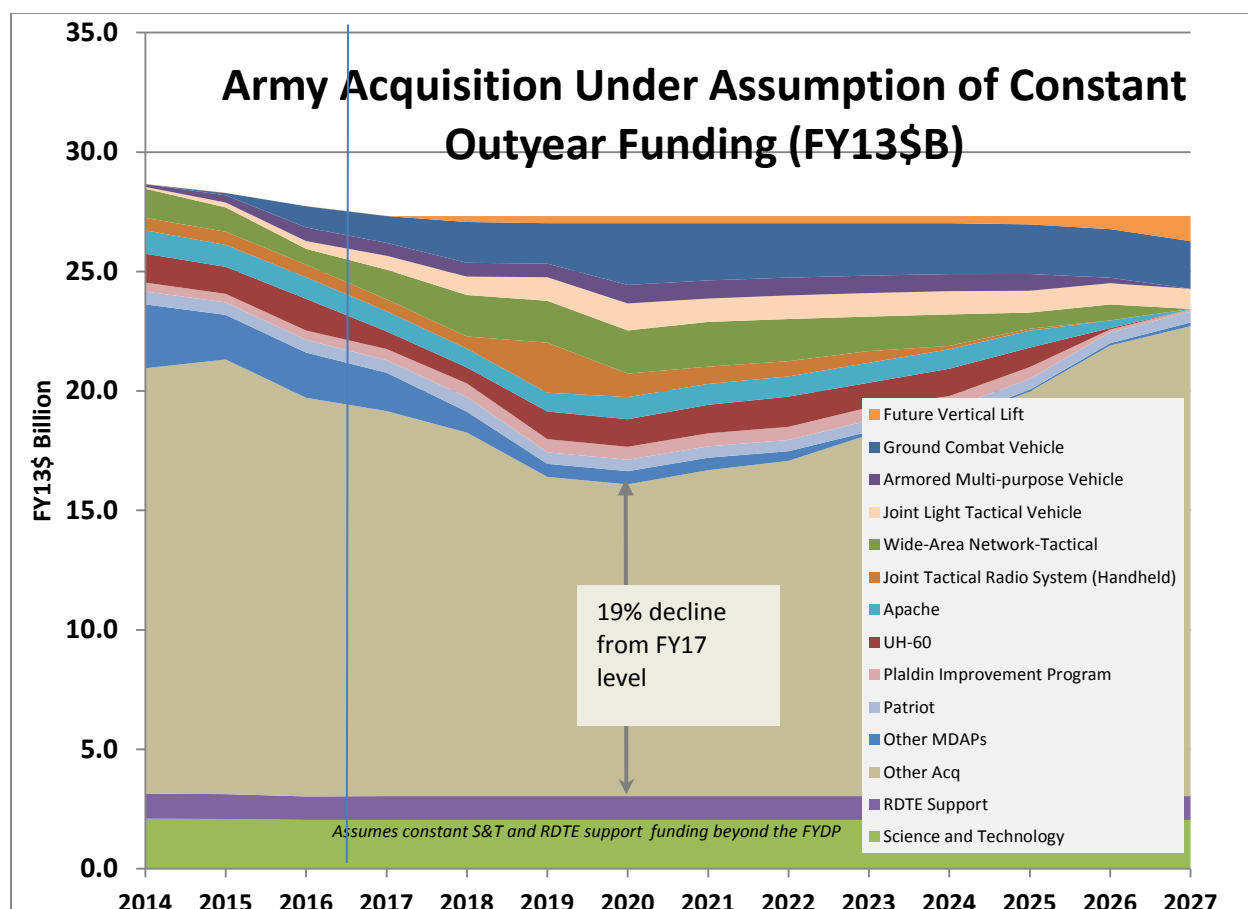


Figure 21. Army Acquisition Baseline Under the Assumption that Funding is Constant, FY2018–FY2027, and that Army MDAPs Execute as Planned

In this case, funding for non-MDAP Army acquisition in FY2020 will be 19 percent below the FY2017 level (which as Figure 21 shows will have already declined by 9.5 percent from the FY2014 level). Without access to the hundreds of detailed lines that comprise this aggregate funding, the study team was unable to assess the impact of such a reduction (even with such data, assessing the impact would be difficult). Unlike the situation when viewed for the entire Department of Defense, in the case of the Army (and Marine Corps) the non-MDAP procurement funding is almost entirely devoted to maintaining a viable inventory of core equipment for the operating forces: trucks and other non-combat vehicles, communications equipment, computers, engineering equipment, materiel-handling equipment, etc. This equipment is vital to the effectiveness of many Army units—both combat and support. In a period where there is a drawdown in forces, a lot of equipment becomes excess, so it may be possible to defer purchase of some types of equipment for cases where the excess inventories can be effectively used. For some types of equipment, especially electronics, obsolescence is more of a problem than wear-out, and maintainability becomes an issue. These considerations illustrate why it is not easy to assess the impact of reductions in aggregate non-MDAP acquisition funding.

However, the scenario in Figure 21 could be much worse if historical growth rates in O&S costs per unit of active duty end-strength continue into the projection period (Figure 22). For the Army those historical growth rates for peacetime are 1.0 percent for MILPERS and 1.6 percent for O&M (over the period FY1972–FY2014). The peaks reflect the much higher operating tempo that occurs during wartime.¹⁸

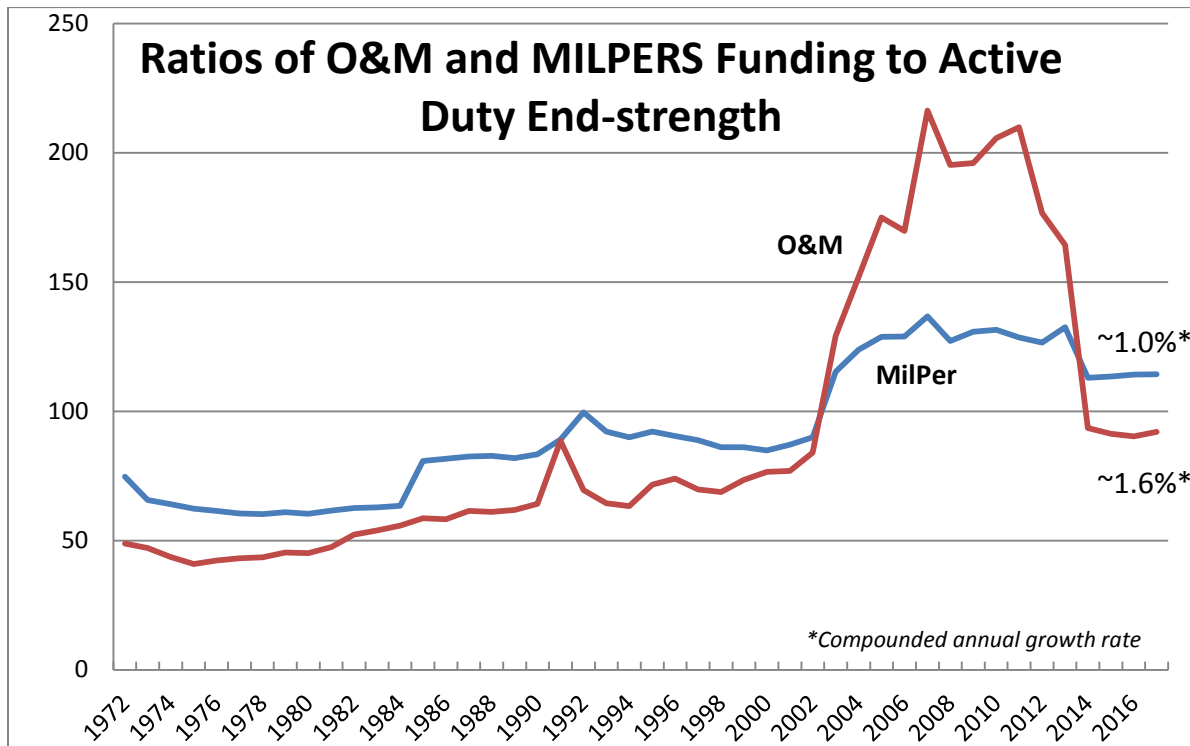


Figure 22. Ratios of Army O&M and MILPERS Funding to Active Duty End-strength

If those growth rates continue beyond the FYDP, if current readiness is maintained, and if the Army topline does not increase, then Army investment funding will have to decrease to accommodate the increase in operating costs while keeping the total Army budget within the expected control totals. This scenario is depicted in Figure 23 and Figure 24.

¹⁸ But don't affect the compounded average growth rates which are based solely on the beginning and end points of the curve.

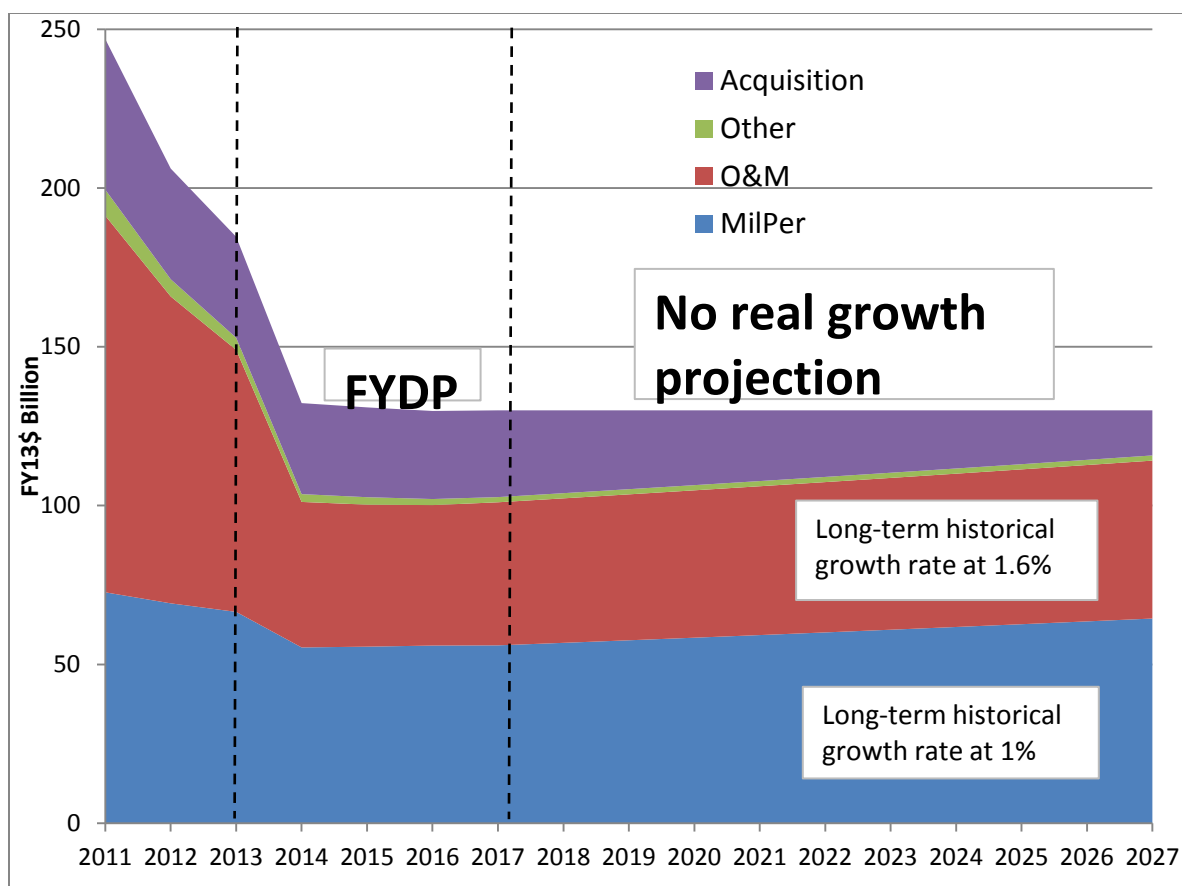


Figure 23. Projections of Army Funding Allocations if Long-term Growth Rates in O&M and MILPERS Continue Beyond the FYDP (and Force Structure Remains Constant)

As explained in greater detail in Appendix C, the funds for O&M and MILPERS for FY2014–FY2017 in the FY2013 President’s Budget¹⁹ do not indicate a continuation of the historical growth patterns (end-strength not associated with contingency operations is projected to be constant). And if the growth continues at historical rates through FY2017 and active end-strength remains constant, the above projection would be even worse in that the starting point for the FY2017 level of Army acquisition would be lower (by about \$1.5 billion in FY2013 dollars). By 2027 Army investment would be reduced by over half the FY2017 level.

¹⁹ Base budget—there is no overseas contingency operation (OCO) funding or manpower in the DOD FYDP beyond FY2013 (however, there is a wedge in the Office of Management and Budget’s 050 “National Defense” account).

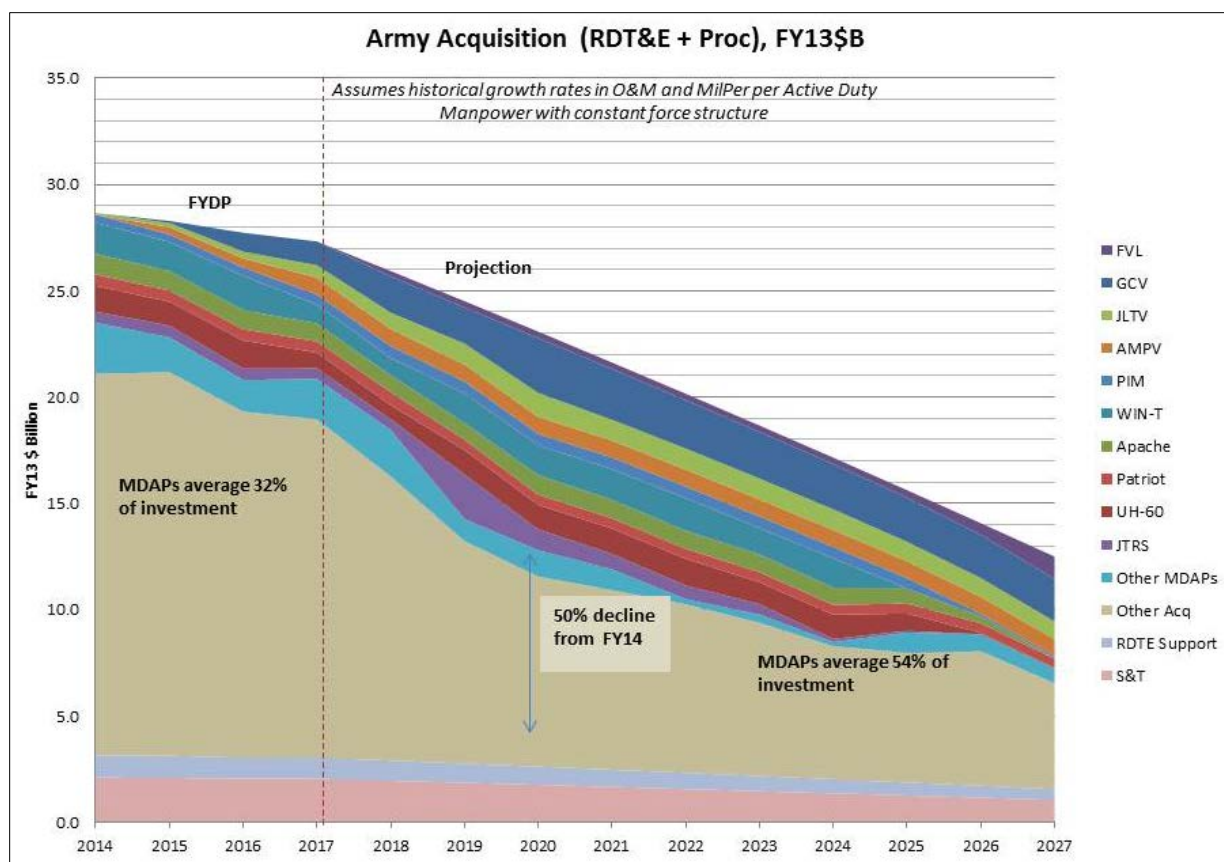


Figure 24. Army Acquisition Projection with Historical Growth in Operating Costs

This scenario for a major reduction in non-MDAP funding is for illustration purposes only; it would almost certainly not unfold in that way. Either funding would have to increase or end-strength would have to be further reduced. A number of MDAPs would certainly be reduced or outright cancelled as well.

While such a reduction may seem draconian, it is not unprecedented. As discussed at some length in Appendix C, reductions in investment funding of that magnitude have occurred in past drawdowns in defense spending as the result of conflict termination or changes in the strategic situation. The larger question for today’s DOD leadership is the level of risk that can be accepted as a result of widespread cancellations, given the strategic guidance currently in effect. That guidance includes direction to avoid mistakes made in past drawdowns that led to hollow forces.

These illustrations effectively make the point that affordability must be a major concern for the Army’s current investment portfolio even under current fiscal plans, but that even more drastic scenarios are clearly possible, given the national fiscal environment projected for the next ten years or more. (A similar situation exists for the other Military Departments—the Army appears to be neither the worst nor the best.) Thus, it can only be said that, should such scenarios come to pass, defense decision-makers will be challenged to provide a level of funding for acquisition that can maintain a modern and effective military force.

B. Ratio Analysis

As suggested in the previous chapter, one approach to assessing the adequacy of acquisition funding is to examine trends in ratios of funding to attempt to capture the acquisition funding level needed to maintain an effective force structure. This study will use the Army to illustrate those ideas quantitatively.

The first measure is the ratio of MDAP funding to total investment funding (excluding S&T and RDT&E support); the trends in this measure are seen in Figure 25.

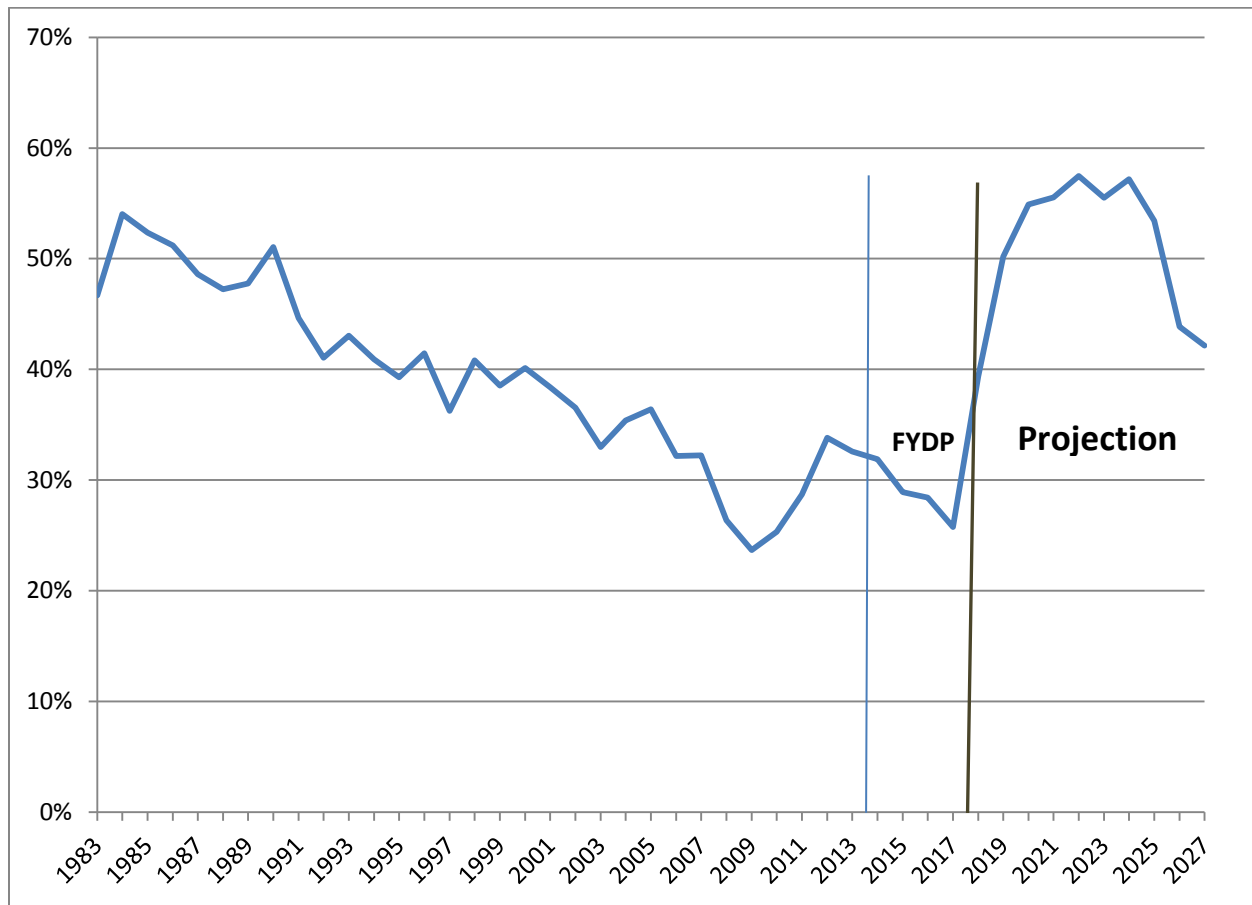


Figure 25. Ratio of Army MDAP Funding to Total Investment Funding

While this graph doesn't support a strong conclusion regarding the share of investment funding that is appropriately applied to MDAPs, the trend in the projection period goes well beyond historical norms.

Next, the study team considered the ratio of acquisition funding to funding of O&S costs. Figure 26 displays the ratio of Army investment funding to O&S funding both historically and through the projection period. The ratio of investment to O&S funding has averaged 27–29 percent over the long-term, but has seen wide variation over time. In the projection period, the ratio will be within historical norms.

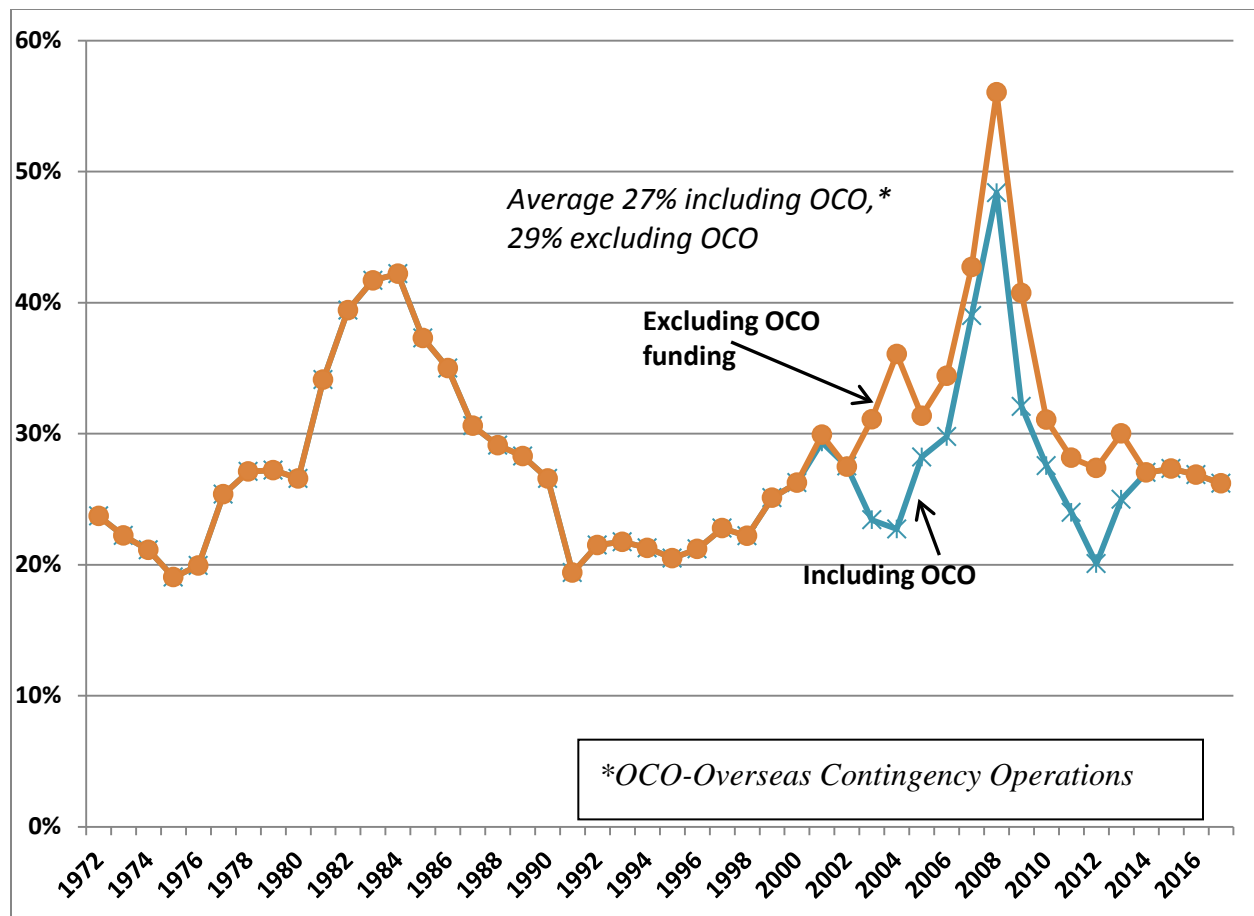


Figure 26. Ratio of Army Investment to O&S Funding

Given that much minor procurement is to support operating forces, the ratio of minor (non-MDAP) procurement to active duty end-strength might provide some insights. The trend in this ratio is seen in Figure 27. The study team only had accurate MDAP data on funding after FY 1997, so the figure shows the ratios for total procurement from FY 1972–1985 and non-MDAP procurement from FY 1997–2016. The graph doesn’t show a clear relationship between force structure (as represented by active duty end-strength) and procurement funding (either total or non-MDAP).

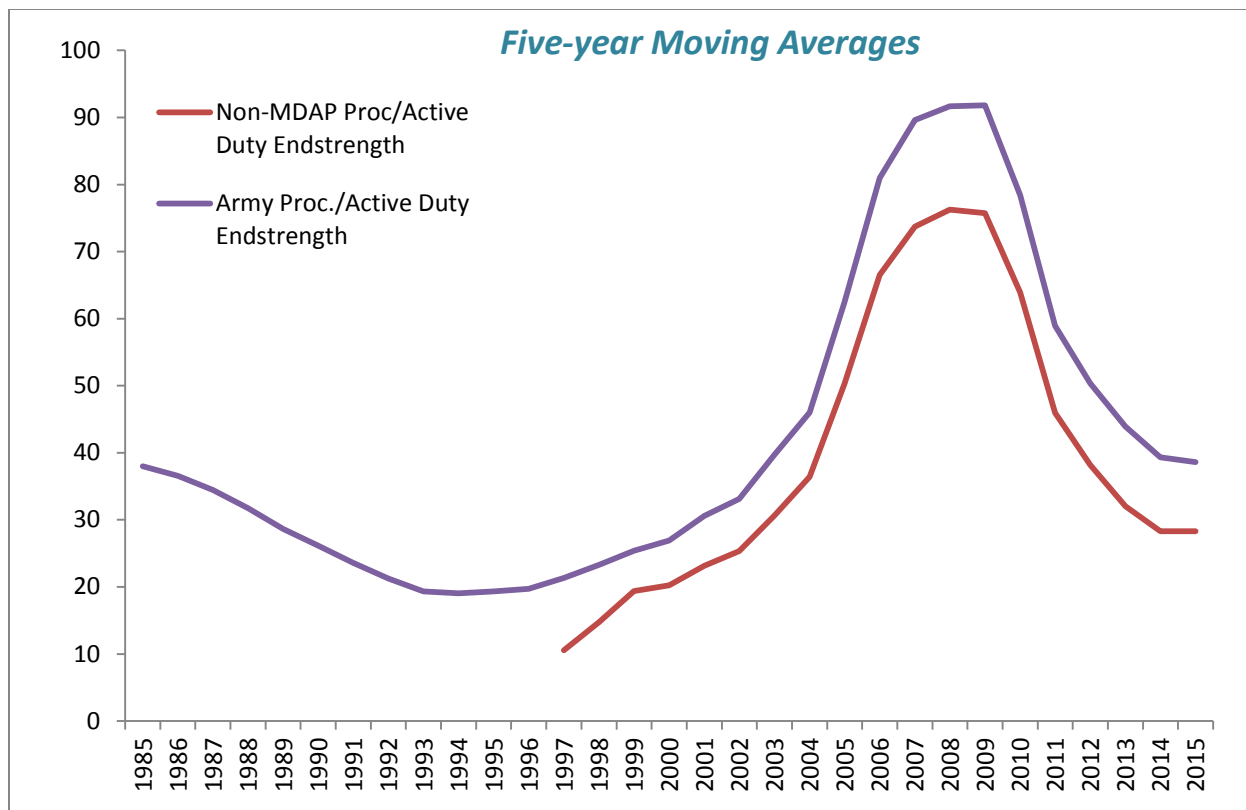


Figure 27. Procurement Funding per Unit of Active Duty End-strength

To sum up these analyses, there appears to be a strong *prima facie* case (especially, given the current fiscal environment) that the Army acquisition program as depicted herein would not be affordable and would not likely be executed even approximately as forecast. Outyear MDAP acquisitions might be executable if the FY2017 level of acquisition funding prevails through 2024, but at the cost of significantly reduced funding in non-MDAP investment, with the level of funding for MDAPs versus non-MDAPs exceeding historical norms in the FY2018–FY2024 period. However, the adverse impacts that such a reduction in non-MDAP investment might have on operating force capabilities or readiness is not easily quantified.

C. Affordability of a Specific Army Acquisition Program

The study team originally set out to perform an affordability assessment for a particular Army program—namely the Armored Multi-Purpose Vehicle (AMPV). The Army plans to replace the M113 family of personnel carriers, and derivatives thereof, that currently populate the Army heavy combat and support forces with AMPVs. Another program, the GCV, is the high-end personnel carrier, or more specifically, infantry fighting vehicle, that the Army is developing to replace some of the BFVs used to both transport mechanized infantry and engage in combat. (Because of the high cost projected for the GCV, the Army does not plan to replace all BFVs with it.) However, because the AMPV program is much less expensive than several

other Army MDAPs, it was evident that the affordability of the overall Army acquisition program was in no way driven by the AMPV program. As can easily be seen in the graphs above, the Army acquisition program would only be slightly more affordable in the absence of the AMPV program.

Army investment affordability is driven largely by WIN-T, GCV, and the helicopter modernization programs, which, in the aggregate, consume 57 percent of the Army MDAP funding over FY2018–FY2024. AMPV is affordable if these other programs are and not if they are not. Of course, AMPV could be one of many smaller programs that might be “sacrificed” in order to fund the big-ticket items. This is an excellent example of why it is impractical to assess the affordability of one acquisition program in isolation, especially a smaller program. This example again makes clear that affordability is another word for prioritization. If, for example, a decision-maker believes that the FY2017 level of investment funding for the Army is unaffordable over FY2018–FY2024, then he or she can construct an affordable program by setting priorities among the candidates for inclusion, combined with considering reducing program costs (most likely with concurrent reductions in capabilities) or changing the time-phasing of production. The next section of this paper will consider options for production scheduling to improve investment affordability for the Army.

9. Use of a Portfolio Optimization (PortOpt) Model for Affordability Assessments: Army Illustrative Example

A. About PortOpt

Since 1998, IDA has worked with OUSD(AT&L) Acquisition Resource Analysis to develop a software tool that can estimate the likely procurement costs of MDAPs under alternative production schedules, and optimize those schedules simultaneously for multiple programs. The optimization is subject to annual budget constraints, minimum and maximum production rates, and endpoint deadlines for delivery of required quantities. The resulting model, called PortOpt (for Portfolio Optimization), was initially deployed in 2002, and has been evolving in both form and use since that time.

The objective of PortOpt is to maximize the benefits of higher production rates to produce quantities of equipment at lower overall costs. Under a given budget constraint, this optimization requires delaying some programs to free up funds for higher production rates of others. However, at the endpoint of the optimization period, all quantity objectives should be met. If that is the case, then the model produces what is called a *feasible solution*. (At some budget level, of course, no feasible solution can be found. Thus a parameter of interest is the *minimum portfolio topline constraint* for which a feasible solution exists.)

PortOpt takes as inputs the procurement cost and quantity projections from the SARs for a portfolio of MDAPs of interest. The user specifies an annual budget constraint for the aggregated procurement costs of those programs by year for an 18-year planning horizon, as well as the minimum and maximum allowable production rates for each program in each year. The PortOpt tool uses the SAR data to estimate parameters in a predictive econometric model. The model treats procurement costs as a combination of program direct costs (subject to learning), annual program operating costs (constant per year), and plant indirect costs (shared proportionately by dollar value among all programs at a plant).

B. Using PortOpt for Affordability Assessments

As noted in the previous chapter, it is generally more useful to view the affordability of a given program in the context of a portfolio of programs rather than in isolation. Affordability is an attribute of collections of activities that are subject to a budget, and the affordability of any

given activity will depend not only on the costs of that activity and on the available budget, but also on that activity's relative priority among the set of all activities competing for those funds.

PortOpt does not attempt to determine which programs to fund and which to cancel. It does, however, predict whether a given portfolio of programs can be purchased within a given budget. It also facilitates investigation of how the total cost (and thus affordability) to procure a portfolio of programs would change as a function of the available annual budget. Finally, it allows the user to estimate the cost impact of adding new programs to an existing portfolio of programs.

This capability suggests a method for assessing the affordability of a proposed set of new programs in the context of an existing portfolio of programs. The steps are as follows:

1. Estimate the budget that will be available for the portfolio of programs in question over the planning horizon and the first year for which deviations from the current plan need to be considered.
2. Use PortOpt to find the optimum production schedules for the portfolio of existing programs within those constraints. This establishes an *optimized baseline* for subsequent analysis.
3. Add the new programs to the PortOpt model, and re-optimize to find the new minimum-cost production schedules.
4. If the optimization in step 3 finds no feasible solution (as defined above), then the expanded portfolio is not affordable within the specified budget. At this point, it might be useful to relax either the budget constraint or the delivery endpoints of the programs, to see how much additional time or funding would be needed to achieve a feasible solution for the expanded portfolio.
5. If the optimization in step 3 finds a feasible solution, then compare the total cost and delivery dates of the new schedule with the optimized baseline schedule (and, in turn, to the original baseline).

PortOpt reveals how much of the marginal cost change is due to the direct cost of the new programs and how much is due to the increased costs (because of less efficient schedules) of the existing programs. That shows why it was necessary to optimize the existing programs to create an optimized baseline—otherwise the difference in cost between the existing plan and the optimized new portfolio would reflect both cost differences attributable to the new programs and those resulting from the optimization of schedules.

It should also be noted that the projected costs of the new programs in the optimized portfolio might be somewhat higher than the planned costs of those programs, if the optimization had to stretch the programs (relative to their plans) to make everything fit under the budget. Cost estimates for pre-MDAP programs are generally developed on the assumption that the program schedule will not be externally constrained by budget considerations, and, thus, will be produced

at the most economical rate. In general, higher rates are more efficient, due to lower fixed costs per unit and higher incentives for contractors to invest in cost-reducing tooling improvements.

Under this method for predicting the cost impacts of adding new programs to the portfolio, the analysis can proceed as before to assess the sensitivity of the result to different budget assumptions. It will sometimes be the case that relatively small changes in the available budget can lead to significant differences in the costs and (especially) delivery schedules of the affected programs.

The method can also be applied to any existing portfolio of programs. In that case, rather than trying to estimate the effect of a change in the portfolio, the focus would be on understanding the sensitivity of cost and affordability to changes in the available budget. This approach is illustrated in the next section.

C. Illustrative Example: Army MDAPs and Pre-MDAPs

Using a subset of the program forecasts and budget estimates described above, the study team assessed the affordability of the procurement portion of the illustrative Army investment as described in the previous section of this paper. The sensitivity of the portfolio's procurement cost and affordability to various levels of its procurement topline budget over the planning horizon was determined. To perform the analysis, the overall Army procurement portfolio was divided into a set of individual programs and program aggregations, as follows:

- Apache Block III
- Armored Multi-Purpose Vehicle (AMPV)
- Bradley Fighting Vehicle System modifications
- Distributed Common Ground Station – Army (DCGS-A)
- Ground Combat Vehicle (GCV)
- Joint Air-to-Ground Missile (JAGM)
- Joint Light Tactical Vehicle (JLTV)
- Joint Tactical Radio System (JTRS)
- M1 Abrams Tank modifications
- Paladin Integrated Management (PIM)
- Patriot modifications
- Patriot PAC-3 Missile Segment Enhancement (MSE)
- UH-60 Blackhawk
- Warfighter Information Network – Tactical (WIN-T)

- Other Army MDAPs (aggregated)
- Army non-MDAP procurement (aggregated)

PortOpt relies on an econometric model of the relationship between production schedule and annual procurement costs. As a result, it can only optimize the schedules of programs for which a clear relationship exists between annual costs and production schedule. Within the above set of programs, no such relationship could be found for the Bradley mods, DCGS-A, the JTRS programs, WIN-T, or Patriot mods. The schedules and costs of those programs, along with the aggregated “Other Army MDAPs” and “Army non-MDAP procurement,” were not subject to change under the optimization routine. Thus, the nine remaining programs, accounting for roughly half of planned Army MDAP procurement costs over the planning horizon, were subject to optimization (see Table 1). In fact, the optimizable programs represent considerably more than half of the discretionary budget, given that the remaining programs tend to be either lower-priority programs that are already at their minimum sustaining rates, or programs suffering technology-related delays that restrict their schedule flexibility.

Table 1. Army MDAP Portfolio by Optimizability

Fixed Cost and Schedule	Optimizable
Patriot Mod	Paladin PIM Mod
DCGS	PAC-3 MSE Missile
Bradley FVS Series Mod	M1 Abrams Tank Mod
JTRS	JLTV
WIN-T	JAGM
Other Army MDAPs	GCV
Other Procurement	AMPV
	Apache Block III
	UH-60 Blackhawk

For purposes of the assessment, the study team assumed that production plans could not be altered within the current FYDP period (i.e., through FY2017) but that any optimizable program could be rescheduled starting in FY2018, subject to constraints on budget, minimum and maximum feasible production rates, and delivery deadlines. For the default delivery deadline, it was specified that the last unit procured must be funded no later than in the current Army schedule for that program. The initial budget used was the total procurement cost of the illustrative Army portfolio through FY2022, with a flat (in real dollars) budget, thereafter at the

planned FY2017 level (the red line in Figure 28). That projection, which is nearly 20 percent higher than the FY2013 level, probably represents an optimistic budget scenario. The optimization was for the period from FY2018 through FY2030.

The results of the optimization of the baseline are shown in Figure 28. PortOpt estimates that this optimized schedule would cost \$4.6 billion less than the baseline schedules (of the illustrative portfolio) over that time horizon, which would be a roughly 2.5 percent reduction in MDAP costs relative to the baseline. This significant potential reduction reflects, in part, the flexibility enabled by the headroom created by a combination of a procurement budget above the FY2017 level through FY2023, followed by a steep drop-off in existing MDAP and identified pre-MDAP funding requirements.

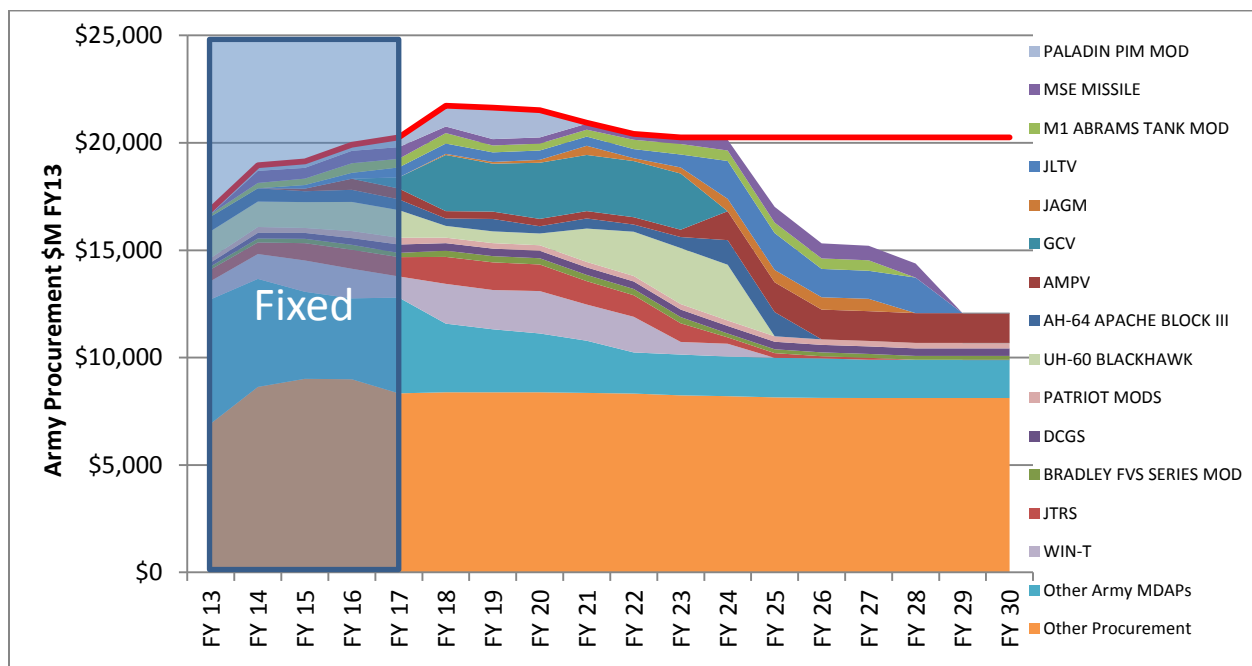


Figure 28. Optimized Baseline Portfolio

To assess the sensitivity of affordability and cost to the budget level assumed, the portfolio was re-optimized under successively lower budget constraints. Each budget in the sequence was chosen to be flat in real dollars. The starting point was a budget topline equal to the FY2017 (end of the FYDP) projection. Figure 29 shows the results of re-optimizing the portfolio within that budget to procure identical quantities of the systems in question. The cost of this optimized schedule is \$1.1 billion higher than the optimized baseline.

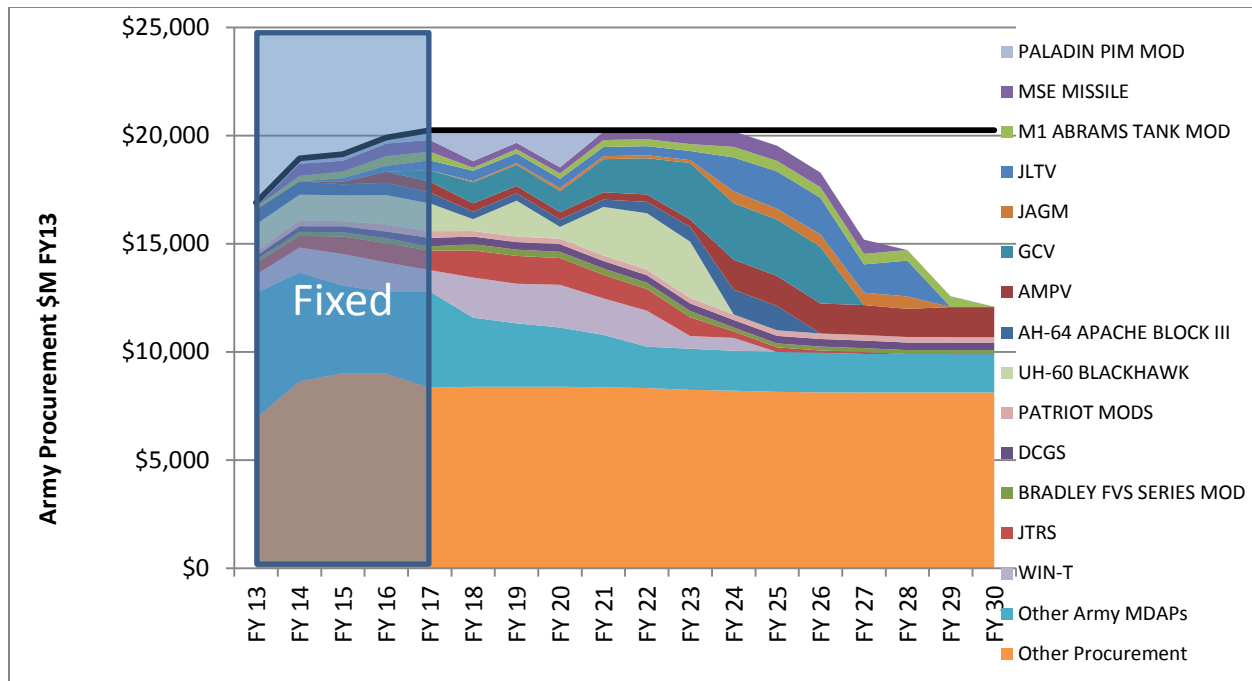


Figure 29. Optimized Schedules Under Reduced Budget

Next, the study team performed a series of optimizations to find the lowest flat budget (for FY2018 and beyond) for which a feasible schedule exists. It was found that the tightest feasible budget, illustrated in Figure 30, is just over \$19 billion per year, or roughly the level of the FY2014–FY2015 budget level (the dotted red line).²⁰ At that level, total procurement costs for the portfolio are projected to be \$3.2 billion higher than under the optimized baseline schedule. More significantly, at that budget there would be no available funding for new MDAPs until FY2027 and beyond.

²⁰ This is the lowest feasible constant budget, even though not all of the money is spent. This is because minimum rate restrictions on existing programs make it impossible to defer any more work to the later years when unused budget is still available.

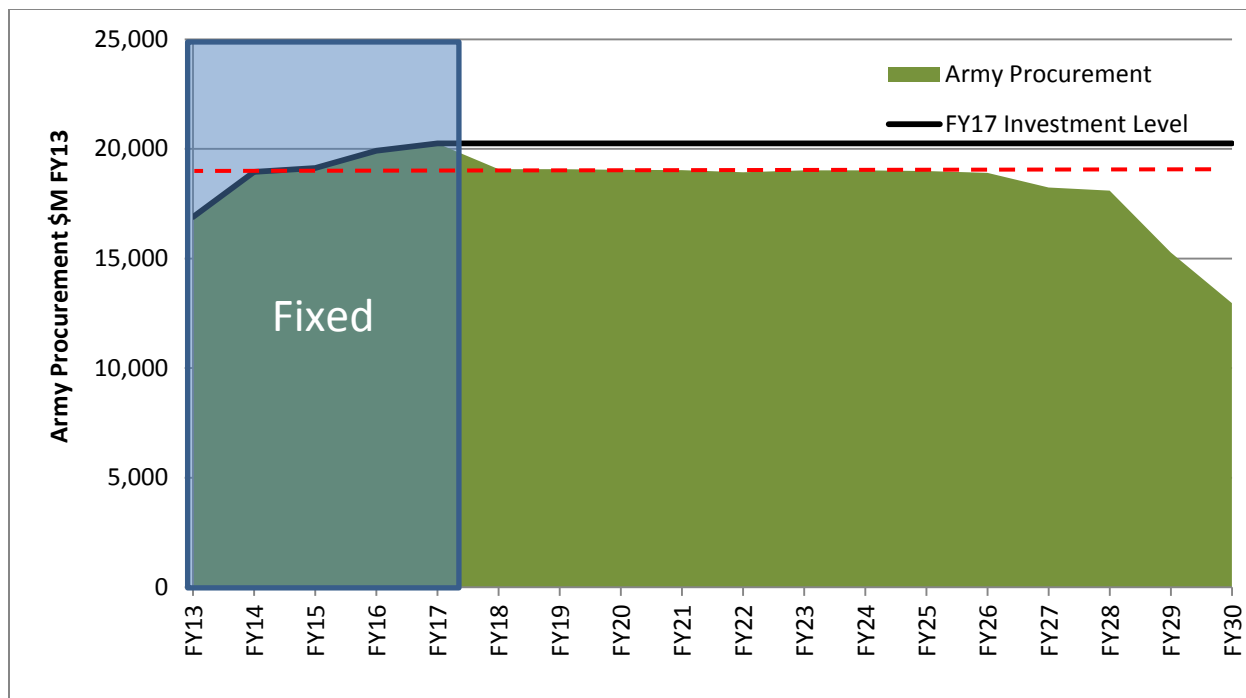


Figure 30. Minimum Feasible Budget

It is informative to look at what happens to individual program schedules under these different budget scenarios. Figure 31 shows the changes in cumulative quantities under three scenarios—the baseline, the optimized baseline, and the program optimized at the FY2017 funding level. Figure 32 shows the annual program funding deltas, relative to the optimized baseline schedule, for each of the optimizable programs under a flat annual budget at the FY2017 level. The large-scale effect is a shift of funding from the earlier years to later years, driven by the tighter budget in those earlier years. At the program level, the optimization resulted in a delay of the GCV program to accelerate the UH-60 Blackhawk program, which ends completely by FY2023. At that point, the GCV program is accelerated to its maximum rate, finishing in the same year as in the optimized baseline. The PAC-3 MSE Missile was also accelerated, finishing one year earlier than in the baseline. It was only necessary to stretch the JAGM and the M1 Abrams mods beyond their baseline schedules.

The impact of a minor reduction in budget from the baseline to the flat FY2017 amount could be minimized by re-optimizing schedules, but only with the penalty of a major reallocation of funds among programs in the portfolio.

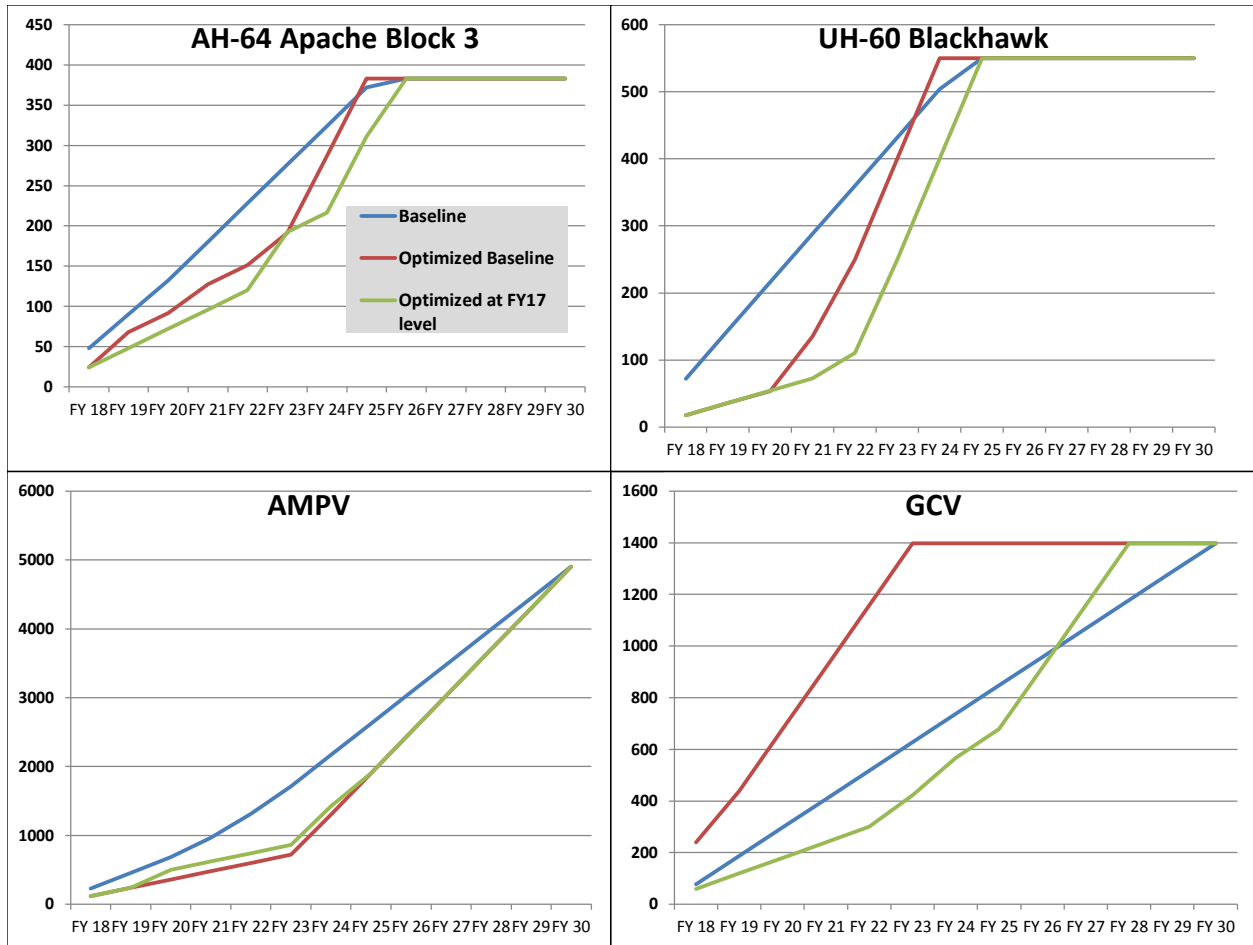


Figure 31. Comparison of Cumulative Procurement Quantities Under PortOpt Optimization—Baseline, Optimized Baseline, and Optimized when Army Procurement is Constrained to the FY2017 Funding Level

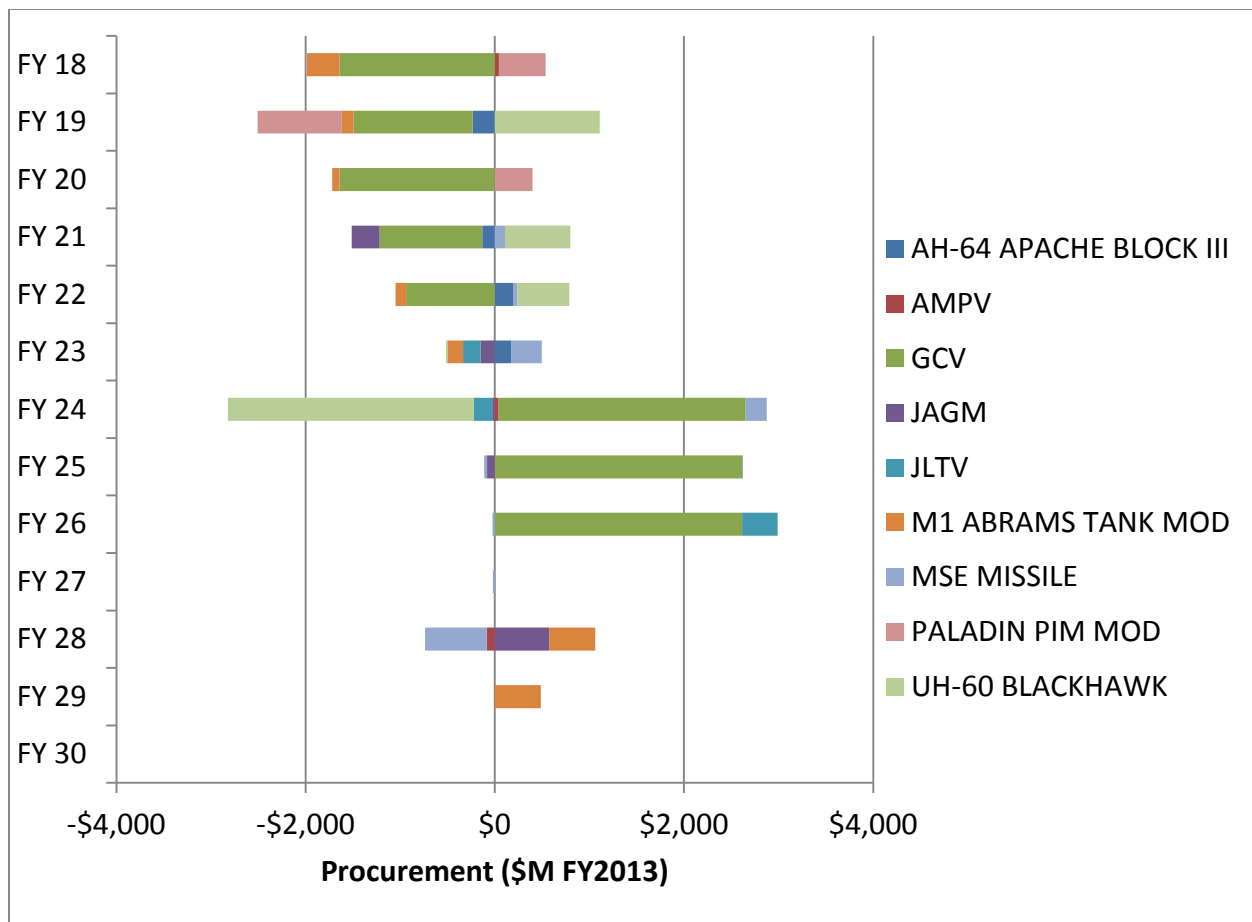


Figure 32. Changes to Funding Required to Execute Programs with Schedules Optimized Under FY2017 Funding Level (Relative to the Optimized Baseline)

10. Conclusions and Recommendations

A. Conclusions

1. Processes for Assessing Affordability

- DOD lacks a coherent and disciplined process for assessing affordability.
- Affordability must be addressed in the context of realistic long term projections of overall fiscal levels at both the DOD and Component levels.

Even though acquisition affordability has been a long-term concern for DOD and Congress (as evidenced by the CBO long-range projections for DOD), DOD has not institutionalized processes for assessing affordability and making appropriate adjustments to ensure that investment programs, from their earliest stages, are well planned within expected portfolio and total funding levels. That is true both at the OSD level and at the Component level. Recent efforts by the USD(AT&L) to institute *affordability guidance* are laudable, but as of the writing of this paper, such guidance has yet to be published. In any event, assuring affordable investment programs is not the responsibility of the USD(AT&L) alone, but is inextricably connected to DOD's overall program planning process—the PPBS.

As discussed in some detail in Chapter 2, affordability cannot be assessed for a particular acquisition program in isolation. Thus, the ability of OSD and Component acquisition executives to evaluate the affordability of a program at acquisition milestone reviews is currently limited, and can be effective only if there exists a comprehensive assessment of the overall affordability of the entire Defense acquisition program in the context of the expected total available funding and other demands. Such an assessment can best be made in the Program Review phase of the DOD and Component PPBS. It follows, therefore, that DOD's guidance to the Components regarding affordability is not the sole purview of the USD(AT&L) but rather a joint responsibility of USD(AT&L) and Director, CAPE. The Military Services apparently share this conclusion and have vested responsibility for affordability analyses within the Service programming communities.

Models like IDA's PortOpt can be used to reduce peaks in the annual procurement funding required by a portfolio of programs by rescheduling production to take advantage of more efficient production rates. While such a rescheduling will likely result in some increases in individual program costs, and possibly in total cost to procure the portfolio, the overall affordability constraints might be preserved by optimizing the scheduling of production.

2. The Defense Program Projection

- The DPP has had little effect on the DOD acquisition milestone decision process.
- The current DPP projection period of fourteen years is inadequate to support long-range acquisition planning.

The DPP is the only long term projection of current, approved DOD plans and programs that is constructed at the DOD-wide level, and is thus a valuable tool for DOD's use in assessing affordability. However, in recent years it has seen only occasional, non-systematic use in that context, in part because it does not draw upon enterprise-wide expertise and information to accurately project forces, programs and plans, together with their fiscal implications, consistent with approved guidance and policies. Greater participation by OSD and the Joint Staff (supported by the DOD Components) in the development of the DPP would address this issue, and enhance the DPP's utility in highlighting affordability challenges. DPP excursions that investigate issues such as the aging and obsolescence of equipment inventories; the implications of long-term growth trends in O&S costs; and expected changes in threats and operational concepts would add to its value for affordability assessments. For example, the DPP might indicate that approval of an expensive new acquisition program is likely to preclude urgently needed replacement or upgrade of existing equipment. Similarly, the DPP can prompt the DOD to reexamine programs focused on a particular threat if current intelligence indicates that the threat has become less likely.

The current projection period of only fourteen years is inconsistent with the recapitalization cycles for long-life DOD assets, especially ships and some aircraft. A thirty-year projection would be more consistent with recapitalization cycles and with the long-range shipbuilding and aircraft procurement plans that DOD submits to Congress with each budget submission.

The CBO longer-range DOD projection employs more sophisticated techniques for estimating the future growth in both acquisition and aggregate O&S costs than does the DPP.

3. Affordability Targets for O&S Costs

- The USD(AT&L) initiative to establish affordability cost targets for O&S is key to ensuring an affordable future force structure.
- Little research appears to have been undertaken to develop better methods for determining and setting targets for O&S costs.

O&S costs for acquisition programs are more difficult to estimate with accuracy than investment costs, and the processes for effective implementation of affordability caps for O&S costs are immature. In particular, while acquisition executives have considerable visibility into and authority over development and production costs, as well as some elements of O&S costs (such as the logistics support concept), the same is not true of the substantial manpower costs incurred in operating and maintaining fielded equipment. Thus, it is essential to isolate those

O&S cost elements that are largely determined by the design and supportability of the major systems, as opposed to those cost elements that can be affected by external factors.²¹

An updated O&S costing guide for acquisition programs, to be published by the Office of Director, CAPE, has been in draft for a number of months, but is not yet published in final form.

B. Recommendations

The study's recommendations follow from the conclusions above:

- The DPP should be revitalized and reconfigured as an OSD-directed project that should be systematically updated after the submission of each President's Budget and with each Component submission of POMs.

The DPP should not be a CAPE-only product. Rather it should be developed in an OSD-led, DOD-wide process with broad participation by all concerned OSD elements and the Joint Staff, with the DOD Components (Military Services and Defense Agencies) playing an advisory role and providing the required information. Such a process would yield a product that is recognized as the most accurate possible representation of the long-term implications of DOD's current plans, as well as of alternatives that should be considered. In addition, the software that supports the DPP should be modernized. Areas for improvement that would help the DPP better inform DOD affordability assessments include: higher fidelity weapon system O&S cost models (especially for Army and Marine Corps systems); better techniques for projecting outyear health care, military pay and other operating and support costs; and incorporation of an inventory aging model into the projection. A model for a more modern system is the Navy's Extended Planning Annex TOA Model discussed in Chapter 7.

- The DPP and the analyses inherent in constructing it should be used in the Program Review to assess in an issue paper both the near- and long-term affordability of the overall DOD acquisition program (including requirements for future new programs) within the context of the total DOD program and projected funding availability. The Secretaries of the Military Departments and other DOD Component heads should ensure that similar processes are in place for their respective Components.
- The Defense Acquisition Board should draw on the DPP and the latest affordability programmatic assessment at each milestone review for MDAP and pre-MDAP programs in order to have a context in which to assess the affordability of the program under review. Programs appearing to be unaffordable in that context *should not be approved*, pending an intensive review to determine the best alternative to restoring

²¹ See Lance M. Roark et al., *Feasibility and Advisability of Baselines for O&S Costs: C-17 Case Study*, IDA Document NS D-4088 (Alexandria, VA: Institute for Defense Analyses, August 2010), for an example of the difficulties in establishing enforceable O&S costs targets.

affordability in the overall DOD acquisition portfolio. Similar processes should be put in place for acquisition programs under Component management.

In order to provide acquisition executives with the information and tools for making well-informed decisions regarding affordability, overall acquisition plans must be constructed based on a set of well-understood assumptions about future force levels, fiscal resources, and future costs of the entire DOD program. That necessity argues for an annual assessment or update of the affordability of the overall DOD acquisition program to be performed as part of the Program Review process. The USD(AT&L) and Director, CAPE should co-lead those assessments.

While acquisition executives are not solely responsible for determining the long-term affordability of acquisition programs at milestone reviews, practically speaking, they are in the best position to enforce an affordability constraint. For MDAPs, CAPE and other members of the Defense Acquisition Board, informed by the most recent Program Review issue paper, can provide the necessary insights to bring the broader defense program and portfolio funding issues to bear in support of acquisition milestone decisions. A similar process should be conducted at Component milestone reviews.

- The USD(AT&L) should encourage Director, CAPE to publish an updated guide for estimating the operating and support cost of all weapons systems, including new starts. O&S cost estimates developed to support acquisition milestone reviews should be examined with the same rigor as investment costs.
- More research should be undertaken to develop better methods for determining and isolating those O&S cost elements that are largely determined by the design and support concepts of MDAPs in development, as opposed to those cost elements that are subject to changes caused by external factors.

There are difficulties in both estimating future O&S costs for weapon systems in development and in establishing sound, enforceable O&S cost targets (especially at Milestone B, which is the system's entry point into Engineering and Manufacturing Development and the key decision point regarding affordability). This shortcoming indicates a need for an increased emphasis on research to develop better methods of assessing future O&S costs for new acquisition systems.

Appendix A

History of the Defense Program Projection and its Use in Affordability Assessments

This appendix will focus on the origins of the Defense Program Projection (DPP) and its early use in affordability assessments for Major Defense Acquisition Programs (MDAP).

Background

The DPP was initiated in the 1988–1989 timeframe by David S.C. Chu, the then Assistant Secretary of Defense (Program Analysis and Evaluation) (ASD(PA&E))¹ and John Christie, then Director Acquisition Policy and Program Integration, in the Office of Under Secretary of Defense, Acquisition (OUSD(A)).² It was part of the response to the July 1989 Defense Management Report (DMR) which called for:

...a rough, 20-year “road map” of the modernization needs and investment plans of DoD, projecting the impact of the Program Planning Objectives, and of additional modernization or replacement of major systems (e.g., ships, aircraft, tanks and satellites) expected by the Military Departments and Defense Agencies, against realistic levels of future funding.³

The DMR in turn was responding to the 1986 Packard Commission report⁴ and the subsequent Goldwater-Nichols Act of 1986. While there is no explicit call for a 20-year investment roadmap in the Packard report per se, the requirement apparently emerged in a subsequent “implementation review” of the report conducted in 1986–87.

At the time, Military Services were required to include an Extended Planning Annex (EPA) with their Program Objective Memorandum (POM) submissions. The EPAs provided Service high-level plans for acquisition of equipment beyond the six-year period covered by the Future Years Defense Program (FYDP). However, by 1987, the EPAs were viewed as providing little

¹ The equivalent current position is the Director, Cost Assessment and Program Evaluation (DCAPE).

² The Under Secretary of Defense, Acquisition (USD(A)) was re-designated the Under Secretary of Defense (Acquisition, Technology and Logistics (USD(AT&L))) in 1999. The successor to the, Director Acquisition, Policy & Program Integration, is the current Director, Acquisition Resources and Analysis, the sponsor of this study.

³ Secretary of Defense Dick Cheney, *Defense Management: Report to the President* (Washington, DC: U.S. Department of Defense, July 1989). <http://www.dtic.mil/dtic/tr/fulltext/u2/a216011.pdf>.

⁴ President’s Blue Ribbon Commission on Defense Management, *A Quest for Excellence: Final Report to the President by the President’s Blue Ribbon Commission on Defense Management* (Washington, DC: The Commission, June 1986).

value. Typically the Services did not take great care in ensuring the accuracy and completeness of the data provided in the EPAs. Furthermore, the EPAs were not sufficiently detailed to support meaningful analysis, and even though they were prepared several weeks after the POMs, they were not always consistent with the POMs.

Thus, as a result of the pressure to undertake more deliberative long-range investment planning, in 1987 the Services were asked to submit more credible, complete, and timely EPAs. Components were directed to assume one percent real growth per annum over the then-projected fiscal year (FY) 1992 topline. (An exception to this assumption was made for manpower costs, which were assumed to increase by 2 percent).⁵ There was considerable “push back” from the Military Services on these future topline assumptions, and analysis of the submitted EPAs indicated that one Service, the Army, refused to follow the specified fiscal constraint.

Frustration with these results led Chu and Christie to propose that the Office of the Secretary of Defense (OSD) develop its own beyond-FYDP projection of the Defense program.

DPP Construction

The first OSD outyear projection was constructed in 1988, and was called the OSD Program Projection, not the DPP. Surviving documentation on that effort is scant. The projection was based on the Defense Mission Category (DMC) structure of the FYDP. The Defense Mission Categories comprise a system for mapping the program elements of the FYDP into a hierarchical set of defined mission categories. The entire DMC code is six digits; however, the DPP resolution is only to the first three digits. See the last page of Appendix B for definitions of the DMC at the three-digit level.

For these early OSD Program Projections in 1988 and 1989, PA&E analysts, working with their counterparts in OUSD(A), manually provided projections within each DMC to cover the balance of the defense program. Data from the Services were obtained via informal staff-level working relationships.

The approach was to collect the planned purchase quantity and annual cost information for each major defense acquisition program (MDAP). This information was taken from the Selected Acquisition Reports (SAR), which are required by law to be submitted at least annually to the Congress.⁶ However, the SARs are only required for programs that have passed Milestone B

⁵ The topline had been reduced because of the end of the cold war, but the outyears of the extant FYDP (FY1990–FY1992) had not been adjusted correspondingly. Thus the EPAs were being constructed without a realistic FYDP behind them. In a memorandum from the Assistant Secretary of Defense, Program Analysis and Evaluation (ASD(PA&E)), the Military Departments were directed to use a Total Obligational Authority (TOA) for FY1992 that was about 15 percent higher than FY1987, whereas that figure in the then-extant FDYP was some 23 percent higher than the FY1987 level.

⁶ The designation of a program as an MDAP is based on thresholds of total program funding projections for research, development, test and evaluation (RDT&E) and procurement specified in law (Currently \$365 million in RDT&E or \$2.19 billion in procurement in FY2000 dollars).

(entry into Engineering and Manufacturing Development). Cost projections for programs in earlier stages of development had to be obtained from the Services—if they existed at all, as were data on new-start programs that had not yet entered the DOD acquisition process at all. Based on their understanding of Service plans, PA&E analysts also manually projected force sizes for the major force components (numbers of divisions, aircraft squadrons, ships, etc.) at the same level of detail as in the FYDP.

However, beginning around 1990, a more formal process was put in place. The Military Departments were officially informed of the process at the *three-star programmer*⁷ level and asked to cooperate based on the ground rule that the projection would be entirely an OSD product, but it would be informed by Service plans and other inputs. A series of meetings was held between OSD and the Service programmers to review outyear acquisition plans within each mission area (as defined by the DMCs at the three-digit level).

In addition, development was initiated on a semi-automated process to build the DPP database. The approach was based on a Force Cost Model, originally developed by IDA for the Joint Staff, but further developed by the Office of the Under Secretary of Defense, Acquisition (OUSD(A)) (now the Office of the Under Secretary of Defense for Acquisition Technology and Logistics (OUSD(AT&L))).

In 1991, PA&E and OUSD(A) published a report completely documenting the process and the results for the DPP undertaking for that year. The projection was for the fiscal years 1998–2003, based on the FY 1992–1997 FYDP. Appendix B contains two appendices from that report. The first is the charter under which the DPP was constructed, signed by Director, Acquisition Policy and Program Integration, OUSD(A), Director, PA&E, and Director, Force Structure, Resources and Assessments, Joint Staff (J-8). The second appendix from the report documented the DPP process, ground rules, key assumptions, and overall methodology (particularly for the non-MDAP, non-force structure elements needed to round out the projection).

The report itself is undated; however, the signatures on the charter are dated February 1991, and the schedule contained in the charter indicates “publication of the baseline projection” in June 1991. The introduction to the report clearly states that the project was being conducted jointly by three offices of the charter signatories. Then it states: “The sponsors have invited the participation of the Military Services (represented by their chief “programmers”) and of OASD(FM&P), OASD(SOLIC), SOCOM, DOD Comptroller, and OUSD(P).”⁸ The purpose was stated thus: “To develop long-term program projections for the Department, to support the planning phase of the PPBS, and to facilitate long-range investment planning as directed by the new DODD 5000.1 and DODI 5000.2.”⁹

⁷ The Service counterparts to OSD(PA&E).

⁸ Office of the Under Secretary of Defense, Acquisition, and Office of the Assistant Secretary of Defense, Program Analysis and Evaluation, (U) *The Defense Program Projection (FY 98-03)*, July 1991, SECRET.

⁹ Ibid.

The charter, displayed in Figure A-1, articulated the purpose more expansively.

To assess the longer term implications of current programs and policies, to include checks on the reasonableness, consistency, clarity, completeness and sustainability of those policies.

To provide an improved analytical basis for addressing macro issues such as major modernization, mission area, and force structure priorities, as well as “pillars” tradeoffs.

To determine whether near-term acquisition programs and long-term investment plans are consistent with force structure plans. Are we planning investments that will prevent undue aging and obsolescence in the future?

To examine (for use in Defense Acquisition Board reviews and in program/budget reviews) the long-term affordability of proposed new starts and current acquisition plans. Will we be able to afford to buy, in sufficient quantities and at economic production rates, the systems we are initiating? Will we be able to man, operate and support these systems?

To assess whether research and development programs will support future system acquisition needs. Are we pursuing the technologies and prototypes to support systems developments that will be needed in the future?

As a basis for more coherent arguments to the White House and the Congress supporting the need for consistency and balance in the long-term defense program.

Figure A-1. The Purpose of the DPP from the 1991 Charter

That statement of purpose remains valid today.

The charter goes on to describe the ground rules for the undertaking:

In phase I of the project, the baseline projection will extend current programs and policies without imposition of explicit fiscal constraints. Current programs and policies will be determined by analysis of FYDPs, System [sic] Acquisition Reports (SARs), Component long-range plans, and documents submitted in the acquisition process. FYDP procurement rates will be extrapolated, unless other rates can be justified by official plans or clearly-defined policy statements. New starts will be limited to those explicitly included in Component approved plans. The force levels, aging trends and other consequences of the projections from these ground rules will be assessed.¹⁰

¹⁰ Ibid., Appendix A, “Charter for the Defense Program Projection.”

The concept behind the new process was to develop cost factors based on information in the FYDP and to use those factors to project costs beyond the FYDP based on the manually-projected force levels and acquisition programs.¹¹ Those calculations produced expected operating and support (O&S) costs for major forces. Purchase quantities and costs for MDAPs, pre-MDAPs, and known potential future MDAPs were projected manually as before. These *detail-line* projections of major programs and activities numbered only about 200 lines, so there was still a large fraction of the defense program left to be projected. (The FYDP comprised about 5,000 program elements at that time.) The rest of the defense program was projected at the three-digit DMC level using an algorithm based on cost factors, or ratios, derived from FYDP data. A pre-processor program took the raw FYDP data and aggregated it into the desired DMC *bins* and computed the FYDP-based ratios used for the automated projections. These algorithms were tested and refined to produce projections that looked plausible. There was a conscious attempt to ensure that the projection algorithms did not drive the answer to any great extent: they were devised to be fairly stable—i.e., not changing dramatically based on changes to the projections made in detail. Regression techniques were rejected because they appeared to produce “noisy” projections. Instead, the DPP made use of simple scaling rules. These automated projections were calculated within each major appropriation category at the three-digit DMC level, and were referred to as *remainders*. Historical FYDP information going back to the early 1980s was used to assess the credibility of funding within the FYDP, and might inform the handcrafted detail line-item projections; however, it was not used in the automated algorithmic projections.

Under this methodology, any line of the FYDP could be projected manually if desired. For example, a manual projection of medical costs was developed based on assuming growth rates of health services, their costs, and the (military and civilian) population being serviced. Similarly, environmental clean-up costs were projected manually, as were operating and sustainment cost factors for systems to be fielded after the FYDP period.

The new semi-automated methodology was less labor-intensive, allowing more focus on the content of the major program projections, and less on programs and funding that varied little over the years.¹² The first product developed with the algorithm-based approach was completed in 1991 and would have been a projection for FY1998–FY2009 (originally the projections were for twelve years beyond the budget year, later they increased to eighteen years).

Emerging Issues

After a couple of cycles of DPP construction, important issues began to emerge:

- **Inaccurate operation and maintenance (O&M) costing within the FYDP period.** O&M funding projected in the FYDP was not consistent with long-term historical

¹¹ The Force Cost Model itself was only used for evaluating alternative force structures within the FYDP. For application to the DPP, the methodology was adapted to enable extrapolation beyond the FYDP.

¹² Or even if they varied a lot but were fundamentally unpredictable—such as war-related funding.

trends in O&M costs, even when normalized (to the extent possible) for changes in force structure. To the extent that FYDP O&M funding was underestimated, any projections based it would be as well.

- **The accuracy of acquisition program costs.** Studies from around that time showed that MDAP costs grew by about 20 percent between initial cost estimates and final production. If such cost growth continued in the future,¹³ both FYDP and DPP funding estimates would be low.
- **Failure to program replacements for aging equipment inventories.** Should the DPP reflect the cost of acquisitions to replace aging equipment inventories in the absence of identifiable program plans that would provide replacements for such equipment (and no plans to draw down the associated force structure)?¹⁴ In many cases existing plans did not include such costs.

These and like issues led to the idea of constructing high and low cases for the DPP, in addition to a baseline. The DPP also illuminated issues regarding program balance and prioritization, since (at least nominally) it provided a long-range quantitative baseline for the DOD resource allocation plan.

A typical pattern was a drop off in acquisition funding in the far outyears when approved programs would be winding down, but (under the ground rules) with no unapproved new programs starting up. This phenomenon would affect the RDT&E accounts first, resulting in their withering away a few years beyond the FYDP. That would most likely be the case for the baseline projection, which probably wouldn't reflect new acquisition and equipment replacement programs starting beyond the FYDP. The high case, on the other hand, might well indicate longer term affordability problems (i.e., in the second six-year period beyond the FYDP) when acquisitions needed to replace aging equipment would materialize.)

Transfer to PA&E

Originally, the DPP was a joint undertaking by PA&E and OUSD(A). But that arrangement endured only until 1994, when the key individual in OUSD(A) responsible for the DPP accepted a position as Principal Deputy Director, PA&E.¹⁵ The then-acting USD(A&T)¹⁶ decided that his office would no longer be a joint sponsor, so responsibility for the DPP fell entirely to PA&E.

¹³ More recent studies confirm that similar levels of cost growth in MDAPs have continued through at least the mid-2000s.

¹⁴ As noted in the charter cited above—in the absence of an approved program to replace aging equipment, “the force levels, aging trends and other consequences of the projections from these ground rules will be assessed.” A subsidiary issue would be what the replacement equipment should be—a similar system or a more capable one, with attendant cost considerations.

¹⁵ By that time, the Assistant Secretary (PA&E) had been demoted to a Director.

¹⁶ In late 1993, the OUSD(A) became the OUSD, Acquisition and Technology. Information on this decision was obtained from an individual who participated in the discussion.

The eventual result was that PA&E began construction of DPPs without any formal participation from AT&L. In fact, until this year, there has been little or no AT&L participation in the DPP process for a number of years. Not coincidentally, there has been little sustained interest from AT&L leadership in issues regarding long-term affordability of the acquisition program and O&M under-funding that the DPP was capable of illuminating.¹⁷

The DPP has always been an informal, close-hold project and has never been incorporated as a formal part of the DOD planning, programming, and budgeting system. While having the advantages of providing greater freedom to DPP analysts to reveal problems and explore alternatives without undue concern about the potential political ramifications, the policy has had the disadvantages of low visibility and even lack of awareness that the product even existed among some DOD managers who might in fact have benefited from the insights it offered.

Affordability

The early DPP quantified investment *bow waves* beyond the FYDP period. While such bow waves were widely understood to exist, the DPP illustrated the problem quantitatively, and thus more fully and credibly. The earlier DPP briefings were classified, so this paper uses as an example the DPP constructed for FY2008–FY2019, for which an unclassified briefing (dated March, 2002) was located in historical files. It showed an outyear topline increase of about \$28 billion (in FY2003 dollars) over the FY2007 level (about 7 percent) by FY2009 from the then-extant FYDP, declining to below the FY2007 level by FY2013. Virtually all the FY2009 increase was in investment—more specifically procurement, which was projected to increase by over 20 percent in FY2008 and remain an average of 23 percent above the FY2007 level over FY2008–FY2013.¹⁸ Figure A-2 shows the investment projection for DOD. This chart depicts an apparent serious affordability problem. The study team has not been able to determine whether specific actions were taken based on that finding.¹⁹ At a minimum, DOD decision-makers were better informed about the problem, which could have had indirect impacts that are difficult to document.

¹⁷ Many occupants of the top DOD acquisition post have been focused almost exclusively on the acquisition process itself, with little interest in broader acquisition-related programming (fiscal) and requirements issues (in contrast to the provisions of the U.S. Code that provide for the position). Thus, while they were concerned with the cost of individual acquisition programs, they were less interested in the overall DOD investment budget and whether it was affordable within the topline.

¹⁸ These figures might stimulate the reader to ask how investment could remain well over the FY2007 level through 2013 while the topline declined to below the FY2007 level by FY2013. The answer is that the chart shows military personnel and operation and maintenance (O&M) constant after FY2008, and an unidentified wedge (funding for GWOT?—a supplemental budget request was submitted the same month as this briefing) comprising about \$10 billion in FY2007 disappearing after FY2009.

¹⁹ Reportedly, outyear procurement for the Marine Corps Advanced Amphibious Assault Vehicle (AAAV) was cancelled by the Secretary of Defense after seeing a DPP briefing. In a more positive instance of the DPP's impact, it was used in discussions with Office of Management and Budget (OMB) that resulted in additional outyear funding being made available to DOD in 1998.

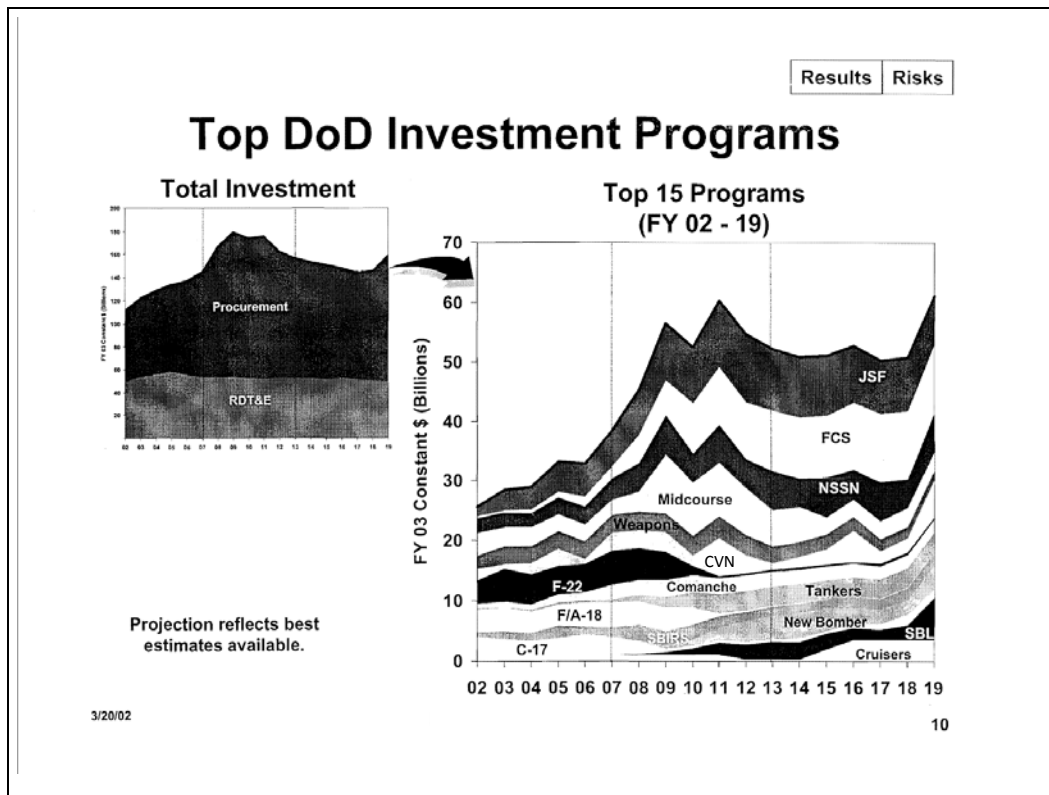


Figure A-2. DOD Investment Projection from DPP for FY2003–FY2011

Broken down by Service, the Army projection averaged over FY2008–FY2013 was 28 percent higher than the FY2007 level, the Navy was 19 percent higher; the Air Force, 8 percent higher; and DOD-wide (driven by ballistic missile defense), 14 percent higher.

As an exercise in intellectual curiosity, the study team has, with the benefit of hindsight, produced a similar chart that shows what actually occurred (actual funding through FY2012 and projected funding in the FY2013 President’s Budget (PB13) submission). It shows actual and projected investment spending for FY2002–FY2017 (FY2017 is the last year included in the PB13 FYDP). Comparisons are confounded by the investment spending in support of operations in Iraq and Afghanistan. It can be noted, however, that of the top fifteen MDAPs shown in Figure A-2, FCS and Comanche were cancelled, and New Bomber and the tanker program were rescheduled to start later. The C-17 buy was extended two more years (by the Congress), F/A-18 procurement three more, and the F-22 ended one year earlier than projected. EELV and V-22 are not shown on the DPP chart, nor is DDG-51 and DDG-1000 (however, there is a wedge for “cruisers” in FY2014–FY2017).²⁰ BMD increased significantly, the Mine Resistant Ambush Protected (MRAP) program was added to address needs in Iraq and Afghanistan, and the P-8A program was added. Interestingly, the total for the top MDAPs still came in at around \$60 billion at the peak (in FY2008 rather than FY2011). Other programs are generally in line with the

²⁰ The Navy is now replacing its cruisers with destroyers.

projection (the “NSSN” is the SSN 774 and “Midcourse” is what became the Ballistic Missile Defense System (as is the SBL (space-based laser)). The Space-Based Infrared System (SBIRS) is still being executed but its funding level did not make the Top-15 list.

The FY2003–FY2019 DPP projected peak investment spending at \$180 billion (in FY2003 dollars) in 2009. Investment actually peaked at \$207 billion (in FY2003 dollars) in FY2008; the increase is driven by spending in support of operations in Iraq and Afghanistan.²¹ It may be of interest to note that, whereas the DPP reflected \$145 billion in investment spending in FY2007 (the last year of the FYDP at the time), the actual amount spent was \$185 billion—some \$40 billion higher.

²¹ With the exception of the Mine Resistant Ambush Protected (MRAP), it is not possible from the available data to separate out all the investment in MDAPs (mostly procurement) spending in support of those operations; two that stand out; however, are UH-60 helicopters and Army trucks, both of which increased significantly in 2008.

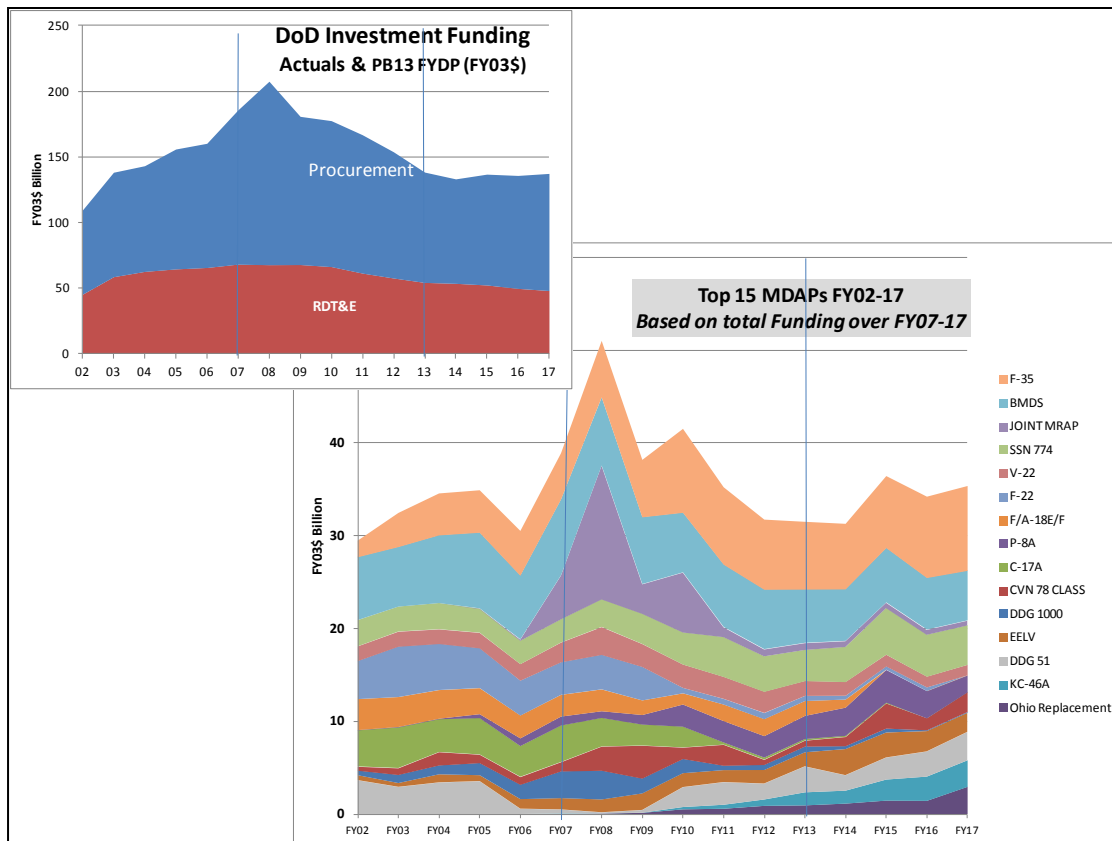


Figure A-3. DOD Actual (FY2003–FY2012) and Projected (FY2013–FY2019) Investment Funding from the FY2013 President’s Budget (in FY2003 Dollars)

Another interesting observation from the FY2003–FY2019 DPP briefing concerns the growth in the ratio of O&M funding to active duty military manpower. The briefing observed that the ratio had been increasing almost steadily since 1980 at about 3 percent per year. However, the FYDP at the time projected a decrease and flattening of the ratio. Actually, a historical increase at about 2.5 percent per year on average has continued to the present day.²² Based on such considerations, the DPP process was able to identify probable underfunding of the FYDP itself. Other non-acquisition areas examined in detail included the Defense Health Program and funding for environmental restoration.

During the late 1980s and early 1990s, affordability assessments were routinely performed by the AT&L staff in support of Defense Acquisition Board (DAB) reviews. In the early 1990s, the DPP provided an excellent context for developing those assessments. The extent to which they actually influenced DAB decisions is another matter.

The case of the Army’s Future Combat System (FCS) is illustrative of the use of the DPP to reveal affordability issues affecting acquisition decisions. The affordability issue for FCS had

²² See, for example, Congressional Budget Office (CBO), *Long-Term Implications of the 2012 Future Years Defense Program* (Washington, DC: CBO, June 2011), 14.

been identified at the Milestone B DAB (reportedly the Army frankly admitted at the DAB that FCS was unaffordable; in approving the program, the Defense Acquisition Executive apparently thought that the funds would be made available for a program that was a virtual poster child for what were known as “transformational” programs so in vogue at the time.) The chart in Figure A-4, prepared (in July 2004) for the next DPP after the DAB, dramatically illustrated a major funding problem looming just beyond the FYDP period. It was several years and several billions of dollars later that the unaffordability of the project, as well as its apparently insoluble technical problems, led to its demise in 2009.

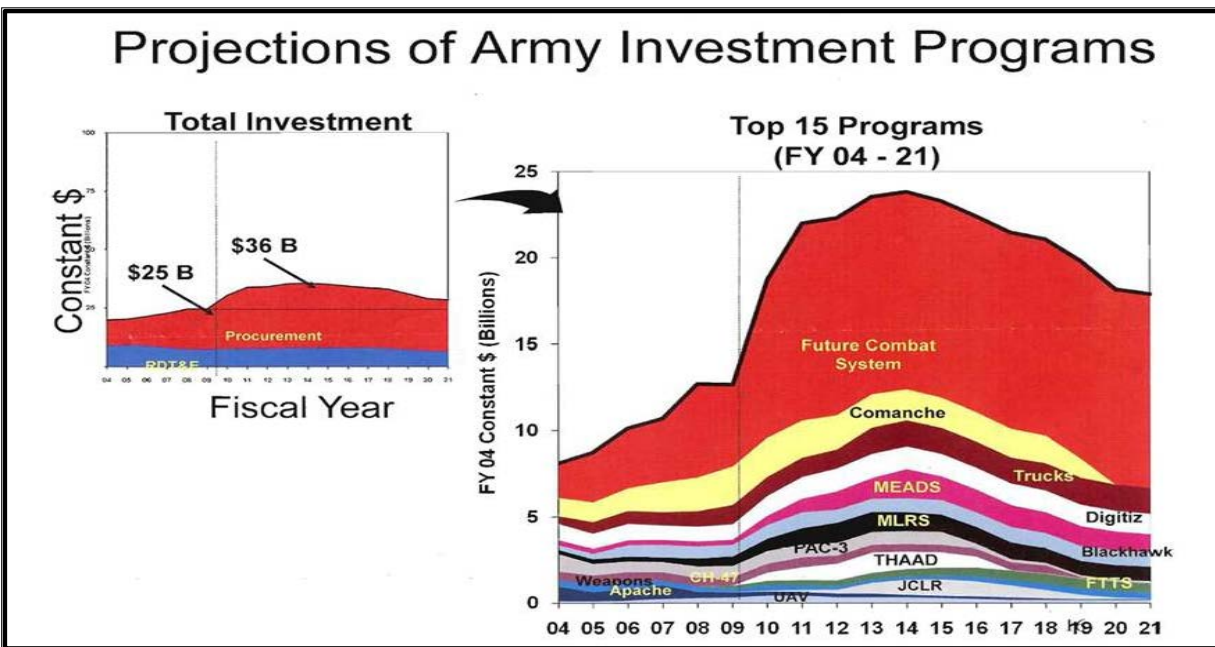


Figure A-4. Projection of the Army Investment Program Presented at Milestone B for the Future Combat System

Appendix B

Historical Defense Program Projection Report

Extracts

This appendix contains extracts from a report on an early 1991 effort to develop a Defense Program Projection (DPP). The overall report is classified; however, three sections that are unclassified are valuable in understanding the ground rules and assumptions that were put in place for that early effort since they are still the principles governing the construction of the DPP ever since.

As discussed in Appendix A, this appendix contains three extracts:

- The charter under which the DPP was constructed, signed by Director, Acquisition Policy and Program Integration, OUSD(A), Director, PA&E, and Director, Force Structure, Resources and Assessments, Joint Staff (J-8).
- A description of the DPP process, ground rules, key assumptions, and overall methodology (particularly for the non-MDAP, non-force structure elements needed to round out the projection)
- The Defense Mission Category (DMC) structure at the three-digit level that was used to frame the development of the DPP database.

Charter for The Defense Program Projection

Background.

Virtually every recent assessment of DoD management has cited the need for better long-range planning. Integrated long-range fiscal planning is necessary to facilitate better decisions on long-term policies for national security and to support near-term programming and budgeting, by illustrating the long-range consequences--in particular, affordability--of programmatic decisions in the aggregate. The Defense Management Review specifies that the Defense Planning Guidance contain:

...a rough, 20-year "road map" of the modernization needs and investment plans of DoD, projecting the impact of the Program Planning Objectives, and of additional modernization or replacement of major systems (e.g., ships, aircraft, tanks and satellites) expected by the Military Departments and Defense Agencies, against realistic levels of future funding.

The new DODD 5000.1 calls for long-range modernization and investment plans and for affordability assessments, and specifies that the general nature of those plans be approved by the Deputy Secretary. DODD 5000.2 specifies that individual acquisition programs be assessed for affordability within overall DOD planning and funding priorities. The OUSD(A) charter assigns to the USD(A) the responsibility to:

develop acquisition plans, strategies, guidance, and assessments, including affordability assessments and investment area analyses, in support of the acquisition Milestone review and Planning, Programming, Budgeting System (PPBS) processes.

Objective.

The Defense Program Projection (DPP) will be a long-term programmatic projection for the DoD, prepared to support the planning phase of the PPBS and to facilitate long-range investment planning. The DPP will consist of a Baseline, which will project the logical consequences of current policies and programs, as well as several excursions from the baseline, considering various fiscal scenarios and policy alternatives. The baseline will extend current budgets and near-year programs to a target year at least six years beyond the FYDP but in less detail than the FYDP. It is needed for the following reasons:

- o To assess the longer term implications of current programs and policies, to include checks on the reasonableness, consistency, clarity, completeness and sustainability of those policies.
- o To provide an improved analytical basis for addressing macro issues such as major modernization, mission area, and force structure priorities, as well as "pillars" tradeoffs.
- o To determine whether near-term acquisition programs and long-term investment plans are consistent with force structure plans. Are we planning investments that will prevent undue aging and obsolescence in the future?

- o To examine (for use in Defense Acquisition Board reviews and in program/budget reviews) the long-term affordability of proposed new starts and current acquisition plans. Will we be able to afford to buy, in sufficient quantities and at economic production rates, the systems we are initiating? Will we be able to man, operate and support these systems?
- o To assess whether research and development programs will support future system acquisition needs. Are we pursuing the technologies and prototypes to support systems developments that will be needed in the future?
- o As a basis for more coherent arguments to the White House and the Congress supporting the need for consistency and balance in the long-term defense program.

The DPP will forecast major acquisition programs, force structure elements, and selected supporting activities explicitly, with derivative aggregate projections of other investment funding and operating and support costs. Detailed projections will be avoided because long-range planning in FYDP-level detail is both infeasible and unnecessary. However, complete fiscal projections by DoD Component and budget category (summing to topline) are required.

Approach.

Defense Mission Categories. The projection will be made within the context of Defense Mission Categories (DMCs). The DMC structure is a mapping of FYDP program elements into a hierarchical mission structure, e.g. strategic; general purpose ground, tactical air, and naval; mobility; special operations; central intelligence and communications; and other support categories.

Projection Process. Within each DMC the major force levels, for those forces contained in the FYDP, will be projected out through the target year. For current major acquisition programs and those major new starts that are projected through the target year, RDT&E and procurement funding and procurement quantities will be estimated explicitly. Estimates of funding for selected supporting activities, such as National Foreign Intelligence Programs (NFIP) and Science and Technology programs (in aggregate) will be made on the basis of approved policies.

Support and Other Costs, and Manpower. All other funding categories will be based on the above specification of forces, major programs, and selected supporting activities, considering historical trends and ratios for the cost to operate and equip forces and provide other support. These support costs will be specified by force element where possible. Costs that cannot be reasonably associated with force elements will be aggregated at the (three-digit) DMC level by DoD component and budget appropriation. Manpower estimates will be made in a similar manner, by active and reserve military and civilian.

Baseline Projection.

In phase 1 of the project, the baseline projection will extend current programs and policies without imposition of explicit fiscal constraints. Current programs and policies will be determined by analysis of FYDPs, System Acquisition Reports (SARs), Component long-range plans, and documents submitted in the acquisition process. FYDP procurement rates will be

extrapolated, unless other rates can be justified by official plans or clearly-defined policy statements. New starts will be limited to those explicitly included in Component approved plans. The force levels, aging trends and other consequences of the projections from these ground rules will be assessed.

Excursions.

In phase 2 of the project, excursions will be defined to illuminate policy choices and explore the imposition of external constraints. Alternative fiscal scenarios will be defined for evaluating the impact of selected fiscal levels. Where the baseline projection results in declining force levels, undue force aging or other problems, excursions will be developed to show funding needed to sustain specified force structures at the size and modernization level of the last year of the FYDP, through higher procurement rates, service-life extension programs, or initiation of new replacement systems.

Organizing for Work.

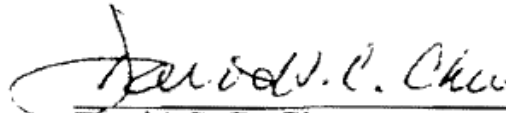
The DPP will be sponsored by USD(A), ASD(PA&E), and J-8, who are solely responsible for its content. The basic force and program estimates will be made by teams of analysts to be established for each DMC. To ensure that the teams have the best available information on future force and program plans, as well as their resource implications, the sponsors will solicit wide participation from the Services, other Components, and other OSD offices. Participants will be invited to name advisors to those teams in which they have an interest. The sponsors will also meet periodically with selected participants to review tentative team projections and to seek their views and advice on issues regarding the appropriate policy and program assumptions for making projections in specific DMCs. The ultimate responsibility for the content of the projection, however, will rest with the sponsors. The assumptions underlying the projection will be clearly specified as part of the document. Once the draft baseline projection is constructed, the sponsors intend to submit it to the Components, other OSD offices and Joint Staff for review and comment. In the excursion analyses, the Components, other OSD offices and Joint Staff will be asked to contribute options for adjusting to specified fiscal constraints to supplement the options developed by the sponsors.

Schedule.

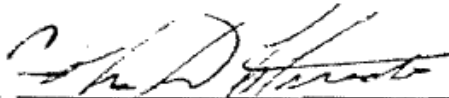
The following milestones will be augmented by more detailed task scheduling from the Steering Group:

- Baseline Projection for comment: April 19, 1991
- Publication of Baseline Projection: June 10, 1991
- Initiate First Excursion: April 12, 1991.
- Excursions available for comment: May 31, 1991
- Publication: Concurrent with the Defense Planning Guidance.

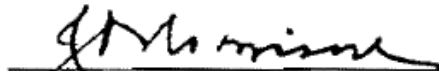
APPROVAL:

 date 21 Feb '91

David S.C. Chu
Assistant Secretary of Defense
Program Analysis & Evaluation

 date 20 Feb 91

John D. Christie
Director
Acquisition Policy & Program Integration, OUSD(A)

 date 19 Feb 91

Major General John D. Robinson
Director, Force Structure, Resources & Assessment (J-8)
Joint Staff

Ground Rules, Key Assumptions and Methodologies

Ground Rules and Assumptions

The more significant ground rules and assumptions have already been mentioned in the overview narrative. The specific assumptions used to generate the projections in the various Defense Mission Categories for forces, defense-wide missions, and defense-wide support are outlined in Part 2 of the DPP document. This section codifies the DPP ground rules, assumptions, and costing methodology more systematically and in more detail. In addition, this section outlines the computer methodology used to project aggregates of the numerous smaller programs that were not explicitly examined (which, in the aggregate, sum to approximately 30% of the total TOA in the projection).

The Defense Program Projection will be accomplished in two phases: the first phase is the "Baseline" projection; the second phase will examine excursions.

The FY92 President's Budget FYDP, as modified by the Amended Budget Submission, is the basis for the Defense Program Projection.

There are no *a priori* fiscal constraints on Phase 1 of the projection, and no *a priori* funding allocations.

The period of the projection is FY98-FY03. Program projections beyond the FYDP are based on:

1. *Explicitly* approved plans, such as Selected Acquisition Reports (SARs), or plans approved in the DAB process.
2. Policy statements, such as Congressional testimony, White House announcements, Presidential and Secretarial speeches or official statements of other ranking officials.
3. *Implicitly* approved plans based on programs in the FYDP--for example, RDT&E initiated in the FYDP. The presumption, unless there are policy statements to the contrary, is that procurement will follow the RDT&E program. The FYDP is recognized to size force and equipment levels under the assumption of CFE and START treaties.
4. FY97 force levels. The Chairman's "base force" will be the long-term force to be maintained.

5. Component plans (Services and Defense Agencies), where they have been recently approved by Component heads.

Procurement rates are in accordance with approved plans or, in their absence, consistent with FYDP rates. Procurement terminates when approved inventory objectives are achieved, or the SAR indicates program termination. Initiation of follow-on programs were at the Sponsors' discretion, based on a degree of consistency with guidance in the FYDP or other policy documents.

The projection includes "programmatic" (explicitly detailed) projections of:

- (1) All major operating forces included in FYDP,
- (2) All acquisition programs on the official list of "Major Defense Acquisition Programs,"
- (3) Other programs of special interest from a policy perspective, or new starts that will become major acquisition programs in the future, and
- (4) Selected smaller programs that cause the aggregated funding lines of all other programs ("remainders") to behave erratically.

In Phase 1, programs *are not* initiated or accelerated because of perceived unmet needs, such as emerging threats, equipment aging/obsolescence, or inventory shortfalls in the absence of any justification based on the above considerations. Phase 1 did, however, identify and document these situations for exploration in Phase 2.

The projection includes force levels, procurement quantities, manpower and funding. All categories of funding are included so as to sum to a DoD TOA estimate--by DoD Component and appropriation, and by DMC. Costs are in FY92 dollars using approved DoD Comptroller deflation indices. Manpower is estimated by active, guard, and reserve and by officer, enlisted, and civilian.

The projection uses Defense Mission Categories, an existing system of mapping FYDP Program Elements into functional mission areas, developed by OASD(PA&E).

Methodology

The DPP is implemented on IBM-compatible microcomputers, using dBASE III databases, Clipper programs, and Lotus 1-2-3-compatible spreadsheets. The basic data are maintained as a set of dBASE III databases. Lotus 1-2-3-compatible spreadsheets are produced from the basic databases to facilitate inputs from the analytical teams and for use in data analysis and graphics.

The basic databases were established from the electronic FYDP using pre-existing software that supports the Advanced Mission-Oriented Resource Display (AMORD) and the Force Acquisition Cost System (FACS). Three special programs to support the DPP were developed in Clipper, a programming system for manipulating dBASE III files. The programs were written by the Institute for Defense Analyses based on detailed specifications provided by the government. The three programs are summarized below:

1. Computation of "Remainder" lines. This program totals the funding *for the FYDP years* (by Resource Identification Code (RIC), a coding system that incorporates budget appropriations but is more detailed) for the programs being explicitly treated ("detail lines") within each 3-digit DMC and subtracts it from the total funding for the RIC and DMC. The result is the "remainder" funding lines for the FYDP years.

2. Computation of Projection-year O&S Costs and Manpower. This program multiplies the force levels that have been explicitly projected by factors to obtain MILPERS and O&M funding and manpower levels (active, guard, reserve; officer and enlisted; and civilians) corresponding to each force element that is explicitly represented. The factors may be set to any desired value, but in the Phase 1 product the factors were derived from the FY94-97 FYDP averages of costs and manpower per force element.

3. Projection of "Remainders." This program projects the "remainder" funding and manpower lines (for each DMC, RIC and Component combination) for the years FY98-03, based on relationships in the FYDP years. The logic used varies by appropriation category (e.g., RDT&E, Procurement, MilCon, MILPERS, and O&M) and, in some cases, by DMC.

The Table following summarizes the logic used in the third program. The basic approach is to use simple linear relationships derived from the FYDP years and applied to the projection years. The linear relationship is generally a factor--the observed value or average of a particular element to be projected divided by a "proxy variable." This factor is then multiplied by the corresponding "proxy variable" for the projection year to obtain the projected value. The Table indicates the proxy variables that are used for each category. A limit, however, is set on the degree to which the total of the detail lines can influence an aggregate "remainder" line. In some cases, the detail lines added to only a small fraction of the "remainder" line for a particular funding category. The program contains limits on the computed factor, and if it exceeds those limits, the FY97 value or the FYDP average is used to extend the remainder line at a constant. The limits, where used, are shown in the Table.

In one important instance, the limit applied unexpectedly--Army O&M funding in DMC 121 (Land Forces). The sum of the detail O&M, which includes all the

divisions, separate brigades, and many separate battalions, is only about one-fourth of the total O&M in the DMC. Therefore, the program reverted to extending the FY97 level of O&M remainder funding. Since this was not intended, for the final projection we plan to increase the limit so that this will not occur.

As an example of how the Table is used, suppose that in DMC 122 we are estimating for FY98 the portion of *Aircraft Procurement, Air Force (APAF)* that is not projected in detail:

- Step 1. For each FYDP year, sum the total MILPERS and O&M for the DMC and add to it the sum of procurement funding for all programs that have been detailed. Average these sums over the FYDP years. (\$5145 MILPERS + \$5033 O&M + \$1786 APAF = \$11964). This is the "proxy variable" or denominator in the table.
- Step 2. Divide the average in step 1 by the APAF "remainder," averaged over FY92-97 (\$1133; quotient = 0.0946). Check if the limit (1) is exceeded; in this case it is not.
- Step 3. Sum the total MILPERS and O&M and procurement funding for all the force elements that have been detailed for FY98. (\$4902 MILPERS + \$5051 O&M + \$4155 procurement = \$13661) This is the "proxy variable" for the projection year.
- Step 4. Multiply the result of Step 3 by the result of Step 2, obtaining the projected remainder APAF (\$1292) for FY98.
- Step 5. Same as Step 4 for FYs 99-03.

Note that use of the total O&S costs, which is viewed as a proxy for force size, provides an "inertia" to the projection of the remainder. If the remainder were projected on the proxy of total detailed APAF only, it would be much larger.

The source code itself, containing numerous comments that serve as documentation, is available on request.

Final Note

The data for the Defense Program Projection are available on IBM-compatible diskettes. If you have questions or would like a copy, please call Elaine Sager, Office of the Director, Planning & Analytical Support, OASD(PA&E), 703-695-4295. For additional information about the DPP methodology and assumptions, or the logic of the computer programs and the structure of the databases, contact Royce Kneee, Office of the Deputy Director, Program Assessment, OUSD(A), 703-695-3773.

Table

**Methodologies used to Project "Remainder" Data Categories
(Funding and Manpower) in the Defense Program Projection**

1. For DMCs 111,112,113,121,122,123,124, and 125

<u>Data Category</u>	<u>Numerator</u>	<u>Denominator</u>	<u>Limit</u>
MilPers	FY94-97 Average MilPers	Total Detailed MilPers	3.5
O&M	FY94-97 Average O&M	Total Detailed O&M	3.5
Manpower (All Categories)	FY94-97 Average value for the category	Total Detailed for the category	None
Procurement (All Categories)	FY92-97 Average value for the category	Sum of Total O&S and Detailed Procurement	1
MilCon	FY92-97 Average MilCon	Sum of Total O&S, total procurement and Detailed MilCon	2
RDT&E	FY92-97 Average RDT&E	Sum of all already-projected TOA in the DMC, less detailed RDT&E	2

2. DMC 126

<u>Data Category</u>	<u>Numerator</u>	<u>Denominator</u>	<u>Limit</u>
All Categories (Services)	FY94-97 Average Value	Sum of all O&S costs in DMCs listed under 1. above for the Service	None
All Categories (Defense Agencies)	FY94-97 Average Value	Sum of all O&S costs in DMCs listed under 1.,totalled over all Services	None

3. DMC 212

Computed like DMC 126 above, with an exception. For this DMC, the team reviewed the Program Elements that comprise it and divided them into those believed to vary with force structure (e.g. communications receivers) and those that support fixed installations (e.g. a satellite ground station). The FYDP funding in each of these categories was totalled, and percentages computed. The result was 42% of the costs were for fixed facilities and 58% would be considered variable with force structure. Thus, for each remainder line, 42% of the value was projected from the FY97 level as constant, while 58% was computed as variable with force structure in the same way as DMC 126.

4. DMCs 231,232,233 and 234

Computed like DMC 126 above.

5. DMC 211

This DMC contains the National Foreign Intelligence (NFIP) Programs. It was projected so as to make NFIP as nearly as possible a fixed percentage of total TOA

<u>Data Category</u>	<u>Numerator</u>	<u>Denominator</u>	<u>Limit</u>
All Categories	FY92-97 Average value	Sum of all TOA in all DMCs & all Components	None

Note: The factor is not computed by Service for this DMC, as is usually the case. All values for all Components are projected based on the change in DoD TOA.

6. DMC 221

<u>Data Category</u>	<u>Numerator</u>	<u>Denominator</u>	<u>Limit</u>
All Categories (Services)	FY92-97 Average value	By Service, total TOA (for Services)in DMCs under 1. above, plus DMCs listed under 2. and 4. above.	None
All Categories (Defense Agencies)	FY92-97 Average value	Total TOA over all Services for the same DMCs as for the Services	None

7. DMC 222

Like DMC 221, except RDT&E funding is used in lieu of TOA.

8. DMC 223

Like DMC 221, except the sum of RDT&E and procurement funding is used in lieu of TOA.

9. DMCs 311,312 and 313

Like DMC 221, except O&M funding is used in lieu of TOA, and average is over FY94-97.

10. DMCs 321,322,323, and 325

Like DMC 221, except MilPers funding is used in lieu of TOA, and average is over FY94-97.

11. DMCs 324 and 326

Like DMC 221, except MilPers funding is used in lieu of TOA, and, instead of an average, the FY97 level is used. This is because these DMCs encompass the Individuals accounts (DMC 324) and DoD Dependent Schools and Family Housing (DMC 326). Because of the force drawdown in Europe over FY94-97, the FY97 endpoint was judged a better basis for projection.

12. DMCs 331 and 333

Like DMC 221, except the sum of MilPers funding and O&M funding is used in lieu of TOA, and average is over FY94-97.

DEFENSE PROGRAM PROJECTION FUNCTIONAL TEAM – DMC MASTER REFERENCE LIST

MAJOR FORCE MISSIONS (DMC 1)

DMC	FUNCTIONAL TEAM AND DMC TITLE	ORG	ROOM	PHONE	CHAIRPERSON
11	STRATEGIC FORCES	PA&E	2E279	X70382	CHARLES SWETT
111	STRATEGIC OFFENSE				
112	STRATEGIC DEFENSE				
113	STRATEGIC C3				
121	LAND FORCES	PA&E	2B256	X73521	PAT SANDERS
121	LAND FORCES			X77085	DEWEY TUCKER (ALT)
122	TACAIR FORCES	PA&E	2C281	X79132	ROY HEMPLEY
122	TACTICAL AIR FORCES				
123	NAVAL FORCES	PA&E	2D312	X70968	DAVE ROSE
123	NAVAL FORCES				
124	MOBILITY FORCES	PA&E	2E314	X73663	MIKE STRICKLAND
124	MOBILITY FORCES				
125	SPECIAL OPERATIONS FORCES	SOLIC	1A674A	X35219	GARY JONES
125	SPECIAL OPERATIONS FORCES		2C270	X70664	MIKE PARMENTIER (ALT)
126	GENERAL PURPOSE SUPPORT	PA&E	2D311	X72999	ART YENGLING
126	GENERAL PURPOSE SUPPORT				
127	THEATER MISSILE DEFENSE	PA&E	2E279	X70382	CHARLES SWETT
127	THEATER MISSILE DEFENSE				

DEFENSE-WIDE MISSIONS (DMC 2)

DMC	FUNCTIONAL TEAM AND DMC TITLE	ORG	ROOM	PHONE	CHAIRPERSON
21	INTELLIGENCE & COMMUNICATIONS	C3I	3D228	X53939	BOB SINER
211	INTELLIGENCE				
212	COMMUNICATIONS				
22	GENERAL R&D	USD(A)	3E1065	X43274	BARRY ELLER
221	SCIENCE & TECHNOLOGY PROGRAM				
222	UNDISTRIBUTED DEVELOPMENT				
223	RD&E MANAGEMENT & SUPPORT				
23	OTHER DEFENSE WIDE MISSIONS	PA&E	2E286	X57725	ALAN STARR
231	GEOGRAPHICAL SCIENCES				
232	SPACE LAUNCH SUPPORT				
233	NUCLEAR WEAPONS SUPPORT				
234	INTERNATIONAL SUPPORT				

DEFENSE-WIDE SUPPORT MISSIONS (DMC 3)

DMC	FUNCTIONAL TEAM AND DMC TITLE	ORG	ROOM	PHONE	CHAIRPERSON
31	LOGISTICS SUPPORT	USD(A)	1E466	X77554	CHARLES ALCORN
311	SUPPLY OPERATIONS				
312	MAINTENANCE OPERATIONS				
313	OTHER LOGISTICS SUPPORT				
32	PERSONNEL SUPPORT	FM&P	3C980	X70617	JOHN ENNS
321	PERSONNEL ACQUISITION				
322	TRAINING				
323	MEDICAL				
324	INDIVIDUALS				
325	FEDERAL AGENCY SUPPORT				
326	OTHER PERSONNEL SUPPORT				
33	OTHER DEFENSE-WIDE SUPPORT	PA&E	2D311	X72999	ART YENGLING
331	DEPARTMENTAL HEADQUARTERS				
332	RETIRED PAY				
333	UNDISTRIBUTED ADJUSTMENTS				

OVERALL OASD (PA&E) POINT OF CONTACT PA&E 2C310 X54295 ELAINE SAGER

OVERALL OUSD (A) POINT OF CONTACT USD(A) 1E466 X53773 ROYCE KNEECE

Appendix C

Implications of Defense Budget Trends for Acquisition Investment

Introduction

This appendix addresses the sponsor's request that the Institute for Defense Analyses (IDA)

Review historical relationships in DOD funding between and among acquisition (MDAPs, other procurement, other RDT&E) and non-acquisition expenditures (Operations & Maintenance, Military Personnel, etc.) to gain insights into the most appropriate fiscal context for considering MDAP affordability.

Materials submitted in support of the President's fiscal year (FY) 2013 budget submission (PB13) project a defense budget *topline*—Office of Management and Budget (OMB) budget function code 051—that will decline about 28 percent (as measured in constant dollars) by FY2014 from a peak in FY2010 (see Table C-1 at the end of this appendix). It will then remain essentially constant (*flat*) through FY2017. This decline is accounted for primarily in the elimination of funding for overseas contingency operations (OCO) accompanying completion of operations in Afghanistan. The *base budget* (i.e., 051 exclusive of OCO funding), will decline modestly before leveling off in FY2014.¹

(This is discussed below and illustrated in Figure C-7.) Moreover, all three major budget categories—Military Personnel (MILPERS), Operation and Maintenance (O&M), and acquisition (i.e., the sum of Procurement and Research, Development, Test and Evaluation (RDT&E))—are projected to be essentially flat from FY2014 through FY2017.

In 2009, IDA published a study² that examined the history of the defense budget since the Vietnam war and projected funds available for procurement through 2030 under several sets of assumptions. Those assumptions included the continuation of historical trends in the budget topline and in costs for MILPERS and O&M. Many of those projections showed very deep reductions in funds available for acquisition in the period roughly FY2015–FY2025.

¹ No overseas contingency operation (OCO) funding is shown beyond 2013 in the budget displays for the 051 account; however, a wedge of \$44.2 billion per year appears under the 050 account. The 051 is a sub-account under 050.

² Shaw, Alan H., Gene H. Porter, and Frank A. Tapparo, *Implications of Defense Budget History for Acquisition Budget 2010- FY2020*, IDA Document D-3995 (Alexandria, VA: Institute for Defense Analyses, December 2009).

The 2009 study identified several major long-term historical trends in the Department of Defense (DOD) budget:

1. Twenty year cycles over which the topline declined (in constant dollars) for ten years, and then grew to another peak over the following ten years. Two complete cycles have occurred since 1969. (The period from 1945 to 1968 displayed a similar trend, although not as well defined).
2. The cost of MILPERS per active duty service member, as measured in constant dollars, has risen at a rate of 1–1.5 percent per year throughout this period.³
3. The cost of O&M per active duty service member, measured in constant dollars, has risen at a rate of about 2.5 percent per year throughout the period.

This appendix updates the 2009 work in light of developments of the past three years. Based on the continuation of historical trends, the 2009 study postulated a budgetary peak in FY2010–FY2011. That peak has now occurred, and the defense budget has begun to decline (in constant dollars). As discussed above, DOD has produced its budgetary projections for the period through FY2017. These projections are based, in part, on plans to reduce active duty end-strength beginning in FY2014 (by about 8 percent from the peak in FY2010); these planned reductions have major budgetary implications. End-strength reductions are a major reason why MILPERS, O&M, and acquisition can all be kept essentially flat through FY2017 under a nearly flat topline. In the absence of those end-strength reductions, growth in MILPERS and O&M would, if continuing at historical rates, exert substantial downward pressure on funds available for acquisition under an assumption of a flat topline. Given the announced end-strength reductions, budgets projected through FY2017 are not inconsistent with continuation of growth in MILPERS and O&M at historical growth rates.

The long-term increases in O&M and MILPERS costs per active duty service member have resulted in percentage swings in acquisition spending that are larger than the percentage swings in the topline for the same years. From 1968 to 1978, the topline lost 40 percent of its value, while funding for acquisition decreased by over 50 percent of its value; from 1989 to 1999, the topline lost 30 percent, while acquisition declined by more than 40 percent.

Like today, reductions in those two periods⁴ were absorbed, in part, by reducing active duty end-strength; force structure reductions also followed during those previous downturns. Increasing costs of MILPERS and O&M per active duty service member were, therefore, offset by reducing the numbers of active duty service members and of major force structure elements. In the absence of these reductions in end-strength and force structure, the reductions in

³ See also Congressional Budget Office, *Long-term Implications of the 2013–2017 Future Years Defense Program* (Washington, DC: CBO, July 2012), 14. Shaw, Porter, and Tapparo, *Implications* cites additional references.

⁴ The period following the peak of spending for the Vietnam war and the period that followed the end of the cold war.

acquisition spending would have been much larger than that noted in the preceding paragraph. Furthermore, in each instance, these reductions in end-strength and force structure were accomplished over a few years, after which the rise in MILPERS and O&M total costs resumed.

In addition to adjusting the results of the 2009 study to take account of events since that paper was published (i.e., actual spending since FY2008 and the production of PB13 with its projections through FY2017), this appendix adds specific consideration of the implications for Major Defense Acquisition Programs (MDAPs),⁵ which are the 100 or so largest acquisition programs in DOD, accounting for some \$74 billion in the DOD spending requested for FY2013. At issue is what the impacts on these programs might be in a future with significantly lower levels of funding available for DOD acquisition in total. If these major programs can't be completed as planned, there could be significant ramifications for the future force structure and overall DOD capabilities. There is also a potential for wasting funding if significant amounts have been expended on programs that are subsequently cancelled when they become unaffordable. Similarly, if production plans are curtailed or stretched due to declining budgets, unit costs will likely go up.

This appendix specifically does not address any additional reductions in spending that might result from budget sequestration under the Budget Control Act of 2011.

The 2009 IDA study also noted that

During the two periods of defense budget decline—1969–1979, 1989–1999—the President's budget asked for less than SECDEF [Secretary of Defense] requested, and Congress appropriated less than the President's budget requested. Through most of those two periods, through six different SECDEFs, the SECDEF's annual report warned that the defense budget was in danger of becoming dangerously low, and future year projections—presumably the basis for planning—typically showed budgetary increases, which were not borne out by subsequent budgets.⁶

The most recent budget upturn began after the attacks of September, 11, 2001 and accelerated with the 2003 invasion of Iraq (Operation Iraqi Freedom). Beginning in 2003, the Bush administration started asking for large supplemental budget requests (*supplementals*) to fund operations in Iraq and Afghanistan. Until 2009, the vast majority of these supplementals were GWOT (Global War on Terrorism) funds; OCO funding began in 2009, and GWOT was discontinued. The Obama administration adopted a policy of explicitly budgeting for OCO (to the degree it could be anticipated) and including it in the budget request, but separately identified.

⁵ The criteria by which programs are designated MDAPs are defined by statute. A Selected Acquisition Report (SAR) is required for each MDAP that has passed Milestone B—entry into Engineering and Manufacturing Development.

⁶ Shaw, Porter, and Tapparo, *Implications*, 11.

While these apparent budget cycles could be purely coincidental—each downturn and subsequent upturn caused exclusively by conditions unique to the specific time—the fact that there have been three such cycles, the regularity, the distinct definition (i.e., large changes in the topline), and the shape of the curve all suggest otherwise. These imply—but do not prove—that there are more fundamental causes at work. Moreover, because the OSD response to downturns frequently is to dispute them,⁷ the IDA study team can conjecture that the cause(s) is(are) not the dynamics of running DOD, but political and economic matters of a higher order, which are then reflected in downward pressure on defense spending.

The PB13 shows that another downturn began in FY2011, has continued during FY2012, is budgeted to continue in FY2013, and is to be followed by a large drop when OCO is eliminated from the DOD budget in FY2014.⁸ The PB13 Future Years Defense Program (FYDP) projects defense Budget Authority (BA) and Total Obligational Authority (TOA) to be essentially flat in constant dollars. (During most of the upturn, the lion's share of the increase was accounted for in OCO and other non-base appropriations.⁹)

Unlike in previous drawdowns, however, the PB13 FYDP provides substantial funding for acquisition investment (procurement plus RDT&E) through FY2017, because it projects that the drawdown in active duty end-strength, combined with short term (i.e., FY2015–FY2017) reductions in the historical rates of growth in the ratios of both O&M and MILPERS to active duty end-strength,¹⁰ will result in essentially flat funding for MILPERS and O&M in constant dollars over FY2014–FY2017.¹¹ Whether or not those figures are actually obtained during the FYDP years, in the longer term it is likely that in the absence of specific, effective control measures, renewed growth in O&M and MILPERS will have their historical impact on acquisition funding, assuming a real-dollar constant topline.

7 Shaw, Porter, and Tapparo, *Implications* cites several issues of the annual defense report to the Congress (no longer prepared) warning that defense budget decreases would be risky, and projecting near future increases rather than continued decreases.

8 However, as already noted, there is a placeholder for OCO within 050 (national defense) of \$44.159 billion then-year dollars for each year FY2014–2017 (See Office of the Under Secretary of Defense (Comptroller), National Defense Budget Estimates for FY2013, the “Green Book” (Washington, DC: Department of Defense, March 2012), Table 1-9, 15).

9 From FY2001 through FY2008, the supplementals were primarily the Global War on Terror (GWOT). In FY2009, OCO supplemental spending was introduced and greatly exceeded GWOT. GWOT disappeared starting in FY2010. Other supplementals have included: (1) hurricane and tsunami relief (FY2005); (2) hurricane relief and avian flu relief (2006); (3) Katrina recovery and Iraq Accountability (2007); (4) Haiti relief (2010).

10 There will be less than 1 percent for the operation and maintenance (O&M) ratio and 0 percent for the military personnel (MILPERS) ratio from FY2014 to FY2017.

11 This is in stark contrast to projections provided in Shaw, Porter and Tapparo, *Implications*, which assumed a constant end-strength, and therefore concluded that continued increases in MILPERS and O&M at long-term historical rates, when combined with a decrease in the topline similar to the previous two downturns, could result in a substantial downturn in acquisition.

At least in principle, MILPERS can be controlled. MILPERS depends primarily on two factors: (1) the size of the force; and (2) total compensation for each military member. As already noted, active duty end-strength is scheduled to decline over the next several years. Assuming Congressional concurrence, increases in compensation can be minimized (or even reversed).¹²

Understanding O&M cost growth, especially over the past decade of large-scale overseas operations, is far beyond the scope of this study. Not surprisingly, both total O&M and base budget O&M have increased far faster than would be predicted by a simple calculation based on the long-term historical growth rate of 2.5 percent per year in O&M per active duty service member. The FY2013 base budget request for O&M is 11 percent more than what it would have been had base O&M simply increased at 2.5 percent per year since 2001.¹³

Before proceeding, two explanatory notes are in order. First, regarding the preceding two paragraphs, it is important to keep in mind that during the preceding decade active duty end-strength has been substantially augmented by the activation and deployment of National Guard and reserve units. Moreover, for many units the deployment tempos (i.e., length of deployment, time between consecutive deployments, etc.) have increased dramatically. The nation has been at war. This has had profound implications for compensation and O&M costs. It is not surprising that O&M has risen faster than what simple continuations of historical rates would suggest.

Second, what follows uses constant dollars (i.e., costs adjusted for inflation). Some of the figures use FY2005 dollars, because 2005 is the base year for constant dollar calculations in the historical tables of the President's Budget. Other figures use FY2013 dollars, because FY2013 is the base year for constant dollar calculations in the Office of the Secretary of Defense (OSD) Comptroller's *National Defense Budget Estimates for FY2013*, the "Green Book."¹⁴ Following the 2009 IDA study, historical discussions are primarily concerned with outlays, that is, what was actually spent in any given year. This was chosen for the simple expedient that the PB historical tables for outlays go farther back in history than the table for BA. For past years, outlays are (at least in principle) exactly known. For future years, outlays can only be estimated based on BA for several years, and are, therefore, a less accurate basis for comparison than is BA. The latter part of this paper, which relies heavily on near-term budget requests and future year projections, therefore uses BA or TOA¹⁵ as the basis for discussion.

¹² Although set by law and government policy, military compensation rates are linked to trends in the civilian economy. Recruitment and retention will be influenced by how military and civilian pay compare.

¹³ The FY2014 O&M base budget is projected to be 8 percent more than what it would have been had base O&M simply increased at 2.5 percent per year since 2001.

¹⁴ Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY2013* (Washington, DC: Department of Defense, March 2012).

¹⁵ Budget Authority (BA) and Total Obligational Authority (TAO) are identical for acquisition accounts and very close for O&M; significant differences (approximately 5 percent) occur in MILPERS (BA is always greater

Brief Review of DOD Budget History

Figure C-1 shows the defense topline (OMB 051 account) outlays from 1962 through FY2017 in constant FY2005 dollars, as reflected in PB13. Outlays through 2011 are actuals; 2012 outlays are estimated, and FY2013–FY2017 amounts are projected.

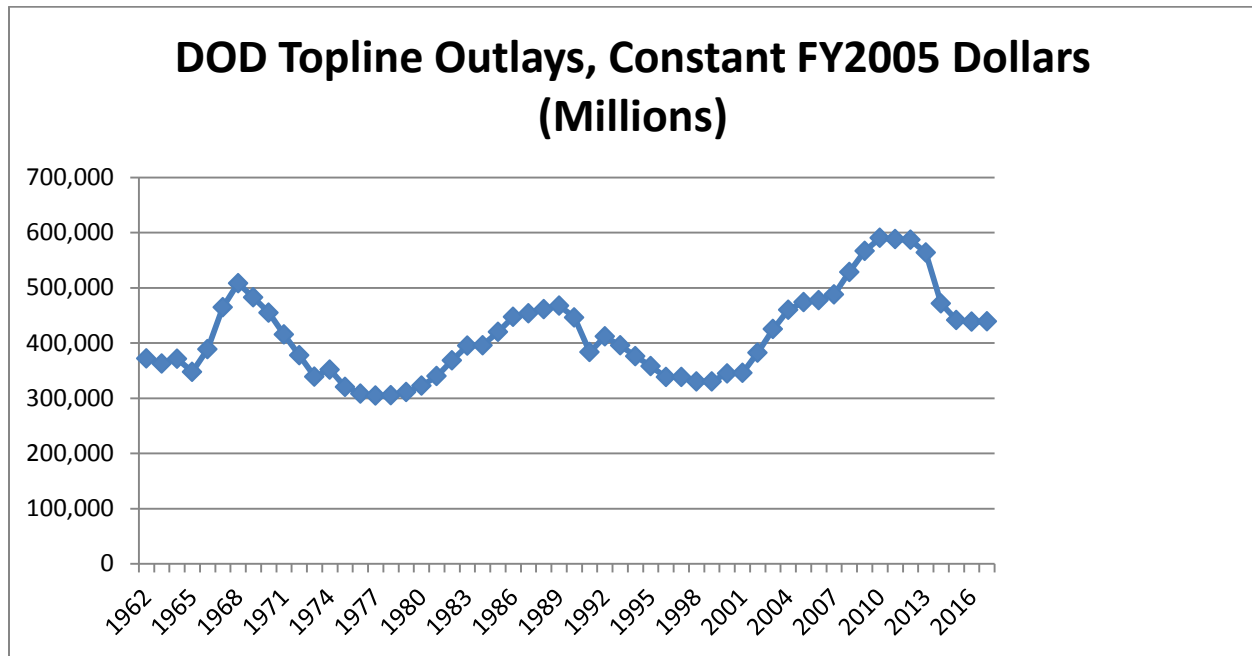


Figure C-1. DOD Outlays in Constant Dollars, FY1962–FY2017

than TOA). As explained in the Green Book, TOA is normally used within DOD, while BA is used for external publication. Outlays, on the other hand, are the best measure for historical funding data.

Figure C-2 shows the same information for the period 1940–1968.

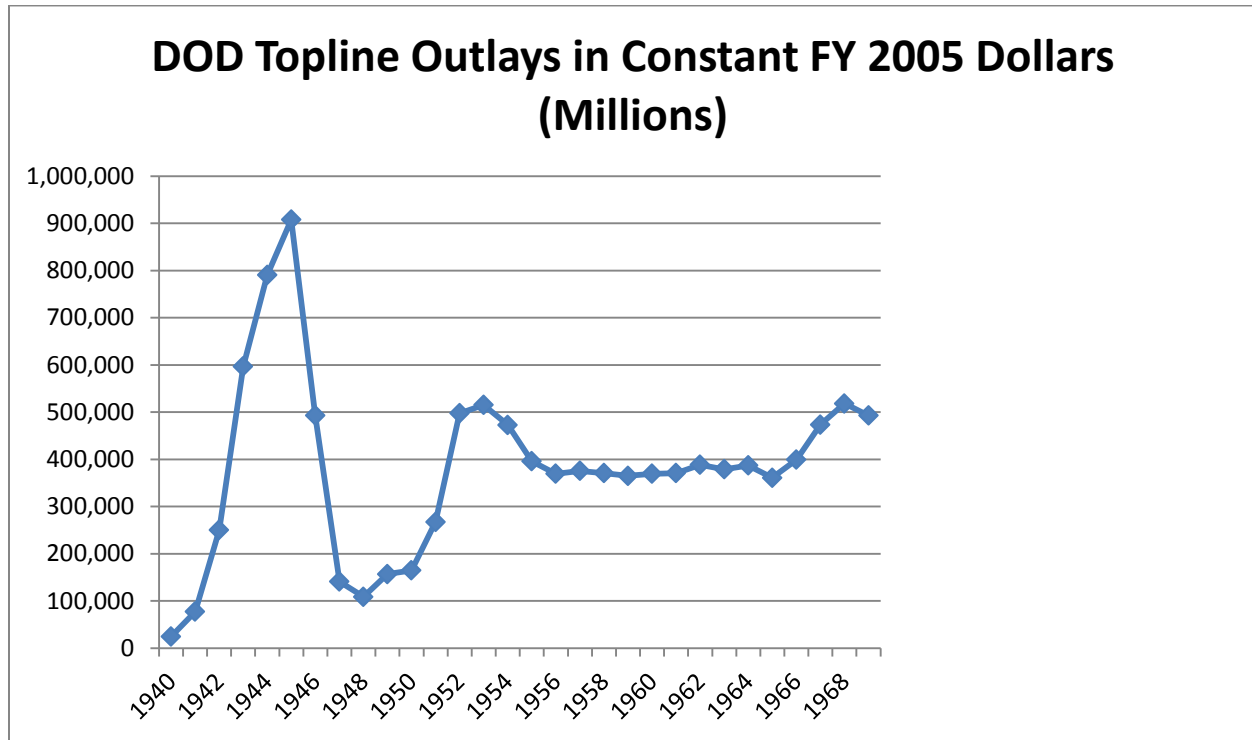
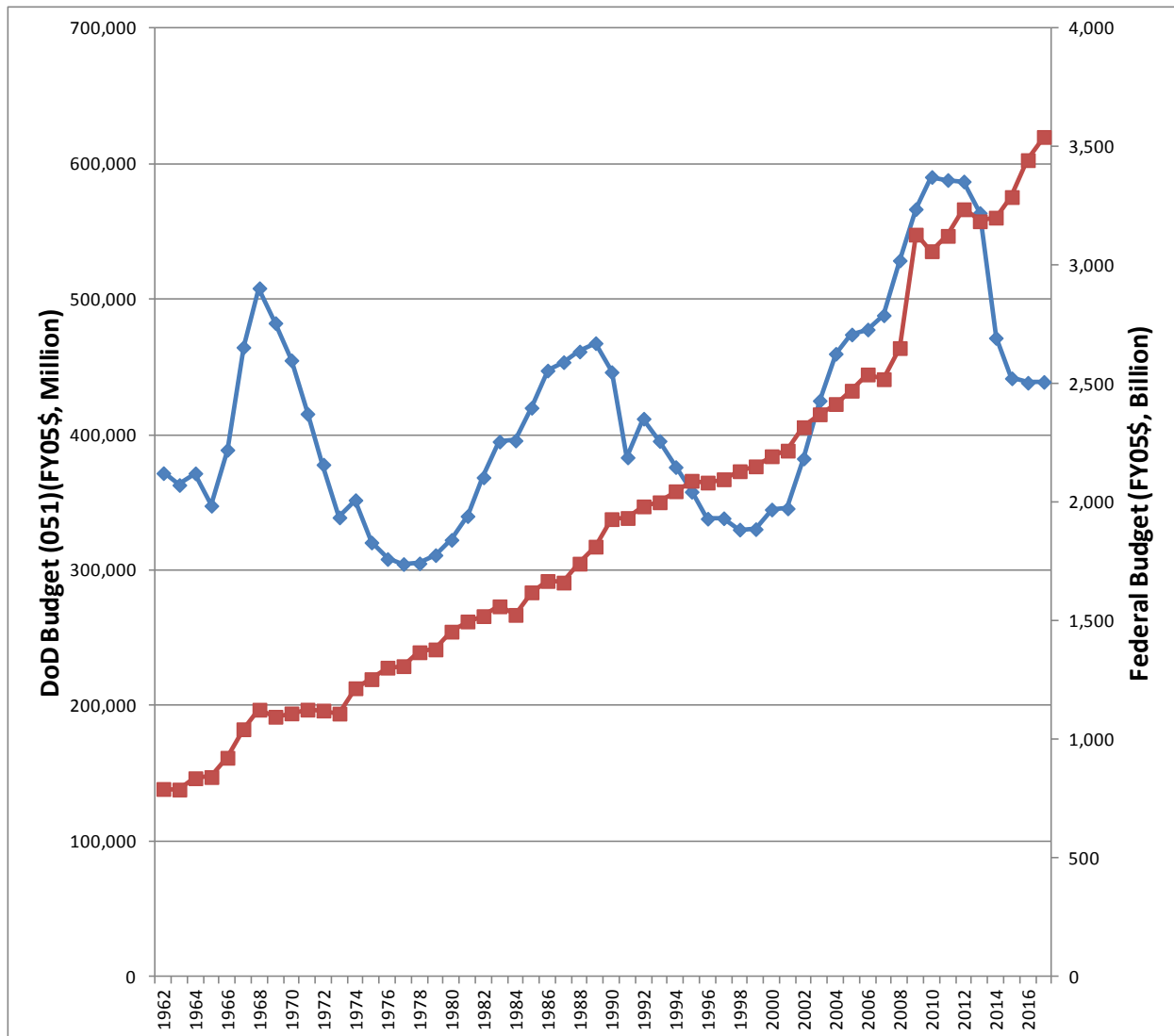


Figure C-2. The Early Years (1940–1968)

While these cycles can be discerned in the total federal outlays, the total federal budget has not followed a similarly cyclical trend. This is illustrated in Figure C-3, which shows the DOD topline and the total federal outlays (scaled for the right-hand vertical axis). This implies that the factors that are causing such swings in the defense budget are likely to have been related to changes in political and/or national security demands, not strictly by overall economic trends.¹⁶

¹⁶ The defense buildup in the late 1960s was a result of demands to prosecute the Vietnam war, while the buildup starting in 2001 was in response to the September 11, 2001 attacks. The 1980s buildup may have been more political than in response to clear national security demands (though one factor might have been the Soviet invasion of Afghanistan in 1979). The drawdown in spending after the Vietnam war had resulted in the *hollow* Army and aging equipment inventories resulting from the *procurement holiday* of the 1970s.



Note: DOD budget shown in blue on the left axis; total federal budget in red on the right axis.

Figure C-3. Trends in DOD Outlays (051) and Total Federal Outlays, 1962–2017 (FY2005 Dollars)

Figure C-4 shows trends in the three largest categories in the DOD budget; the 2009 IDA study noted the following regarding these trends:

- The declines in acquisition during each of the downturns were larger, in fractional terms, than the declines in the topline.
- MILPERS, although it follows the cycles, has been trending generally downward, at least until the beginning of the 21st century. This trend is attributable to reductions in end-strength; in the absence of these reductions, the steady rise in the cost per active duty service member would have produced a steady increase.

- O&M, which was the smallest of these three major categories in 1968, has been following a long-term upward trend, and is now the largest of the three. In constant dollars, O&M is now twice as large as it was at the height of the Vietnam war.
- The long-term growth in O&M has occurred despite reductions in end-strength and force structure. (A detailed examination of the growth components of O&M is needed but is beyond the scope of this study.)

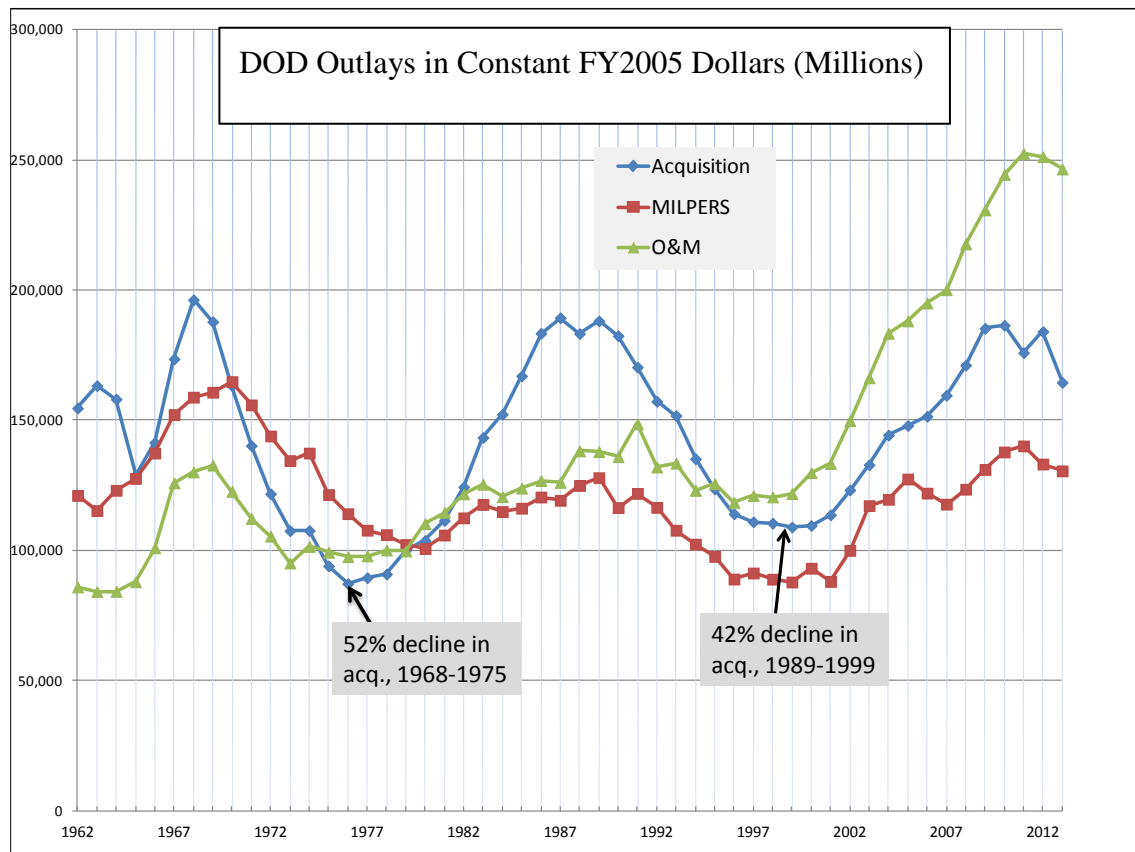


Figure C-4. Outlays 1962–FY2013 for O&M, MILPERS, and Acquisition (Sum of Procurement and RDT&E)

The budget also contains funds for several smaller categories, the largest of which is generally military construction (MILCON). These vary from year to year, and typically sum to \$20–\$30 billion (2–4 percent of topline). While this is a significant amount of money, it is not important when considering these three major categories.

The President's Budget and FYDP for FY2013

Figure C-5 displays recent and projected BA for the DOD topline, O&M, MILPERS, and acquisition in FY2013 constant dollars, taken from the OMB presentation of the President's Budget and from the FY2013 "Green Book."

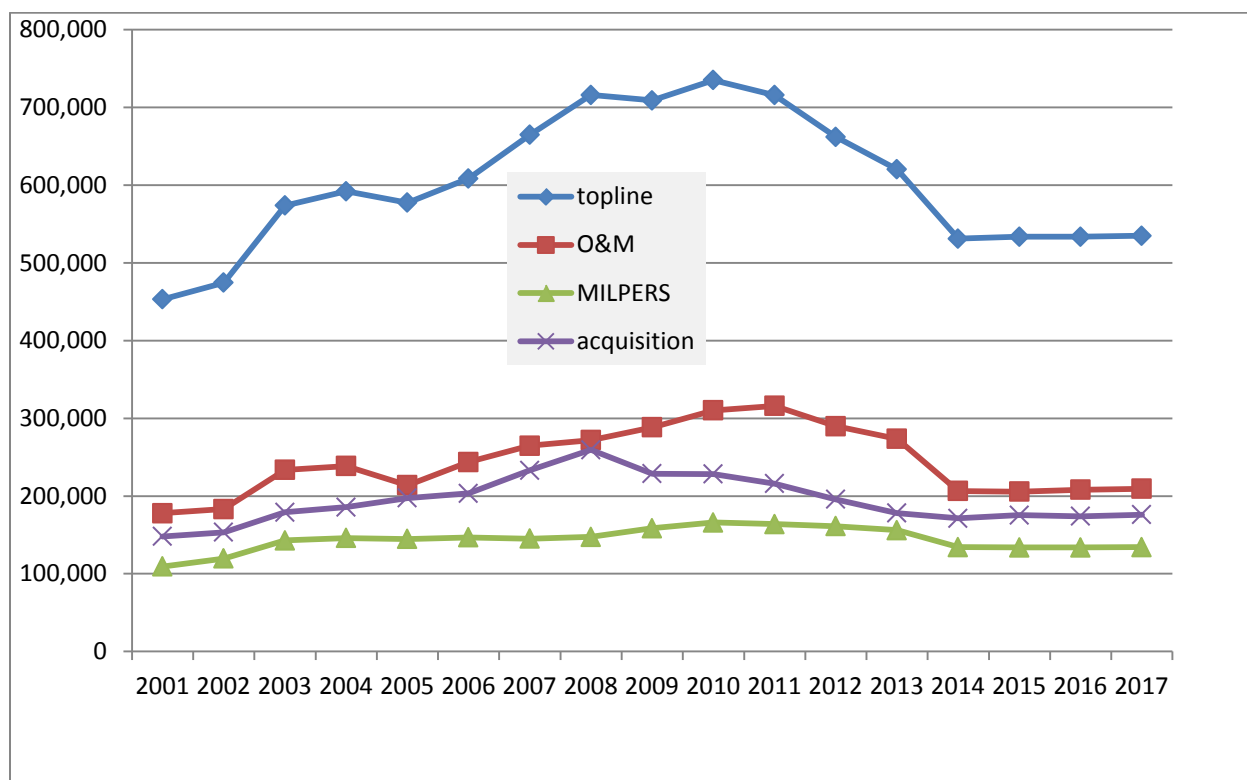


Figure C-5. Budget Authority in Millions of FY2013

This shows a downturn lasting approximately four years, followed by a period during which the budget is nearly flat in constant dollars.

Figure C-6 compares the shape of this projected downturn with the shapes of the downturns that occurred roughly twenty years earlier and forty years earlier.

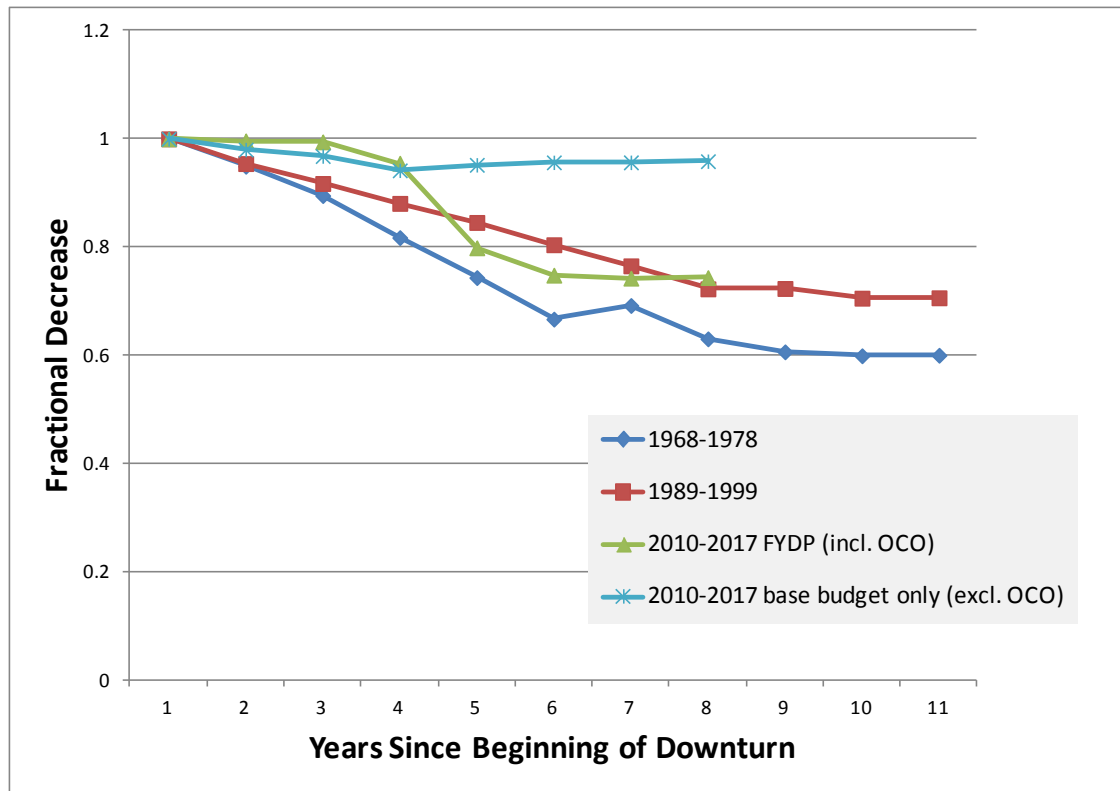
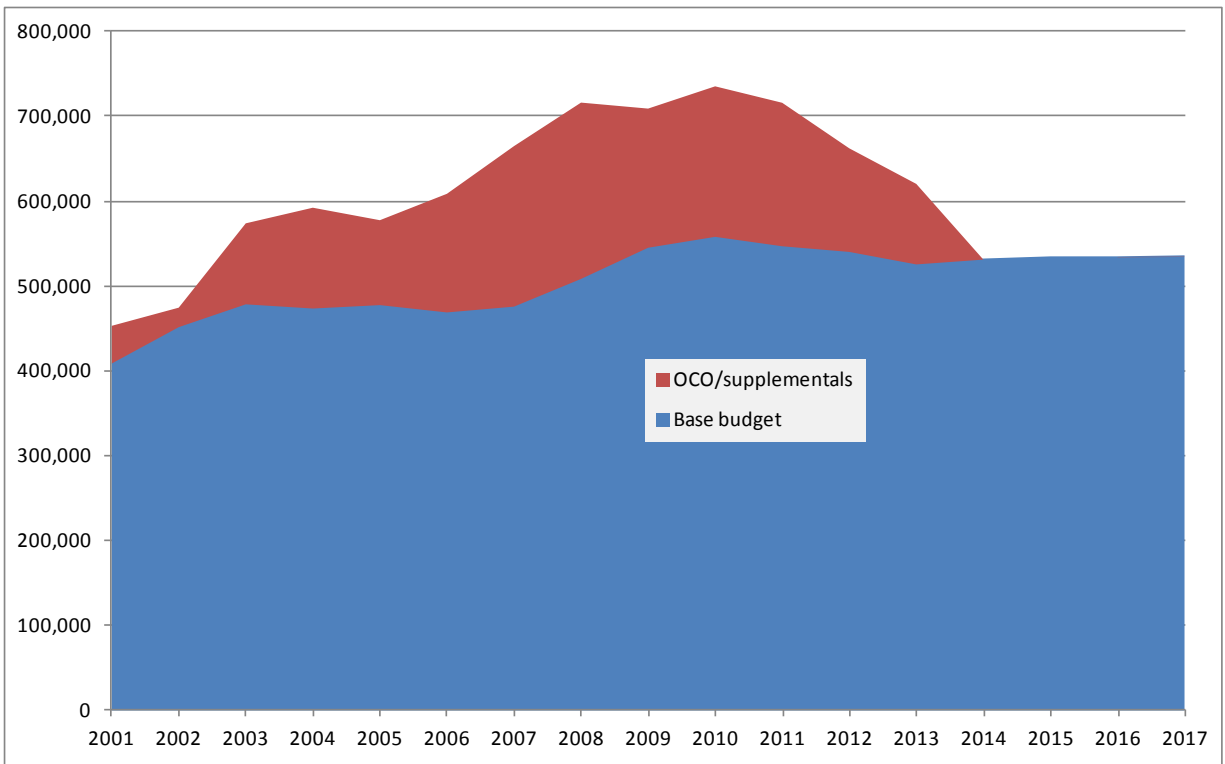


Figure C-6. Topline Downturn Profiles—Fractional Reductions

The shape of the downturn projected in the PB13 FYDP is consistent with history in that it falls about 25 percent. However, compared to previous downturns, the current drawdown falls more quickly and ends more abruptly, whereas previous drawdowns were more gradual (and in 1968–1978, significantly deeper, –37 percent versus –25 percent). Moreover, since the planned reductions are primarily due to the termination of OCO, the base budget itself declines by only about 5 percent and then begins a small increase.

The relationship of the base budget and OCO funding is displayed in Figure C-7.



**Figure C-7. Budget Authority in Constant FY2013 Dollars (Millions);
Base Budget and OCO/Supplementals**

On one level, this separation between base budget and OCO/supplementals would seem simple and straightforward. Funds appropriated through supplemental appropriations or for requests explicitly labeled “OCO, GWOT,” etc. are OCO/supplemental, and everything else is, therefore, base budget. However, it is not possible to know what would have been spent had there been no contingency for which supplemental funds were appropriated. For example, much, perhaps all, of the operating costs of deployed forces is funded in supplementals, whereas if there was no contingency funding, their operating costs (presumably lower) would be funded in the base budget.¹⁷

Figure C-8 compares the PB13 base budget FYDP O&M with a computed projection based on an assumption of continued increase from the FY2011 amount at 2.5 percent per year per active duty service member. These gross trends are roughly consistent, but far from identical.

¹⁷ Informal discussions with personnel in the Service programming community have stated as much—that without the OCO funding, their outyear program is underfunded. The extent of this problem is not known, but the consequences could have a significant impact on funds available for investment.

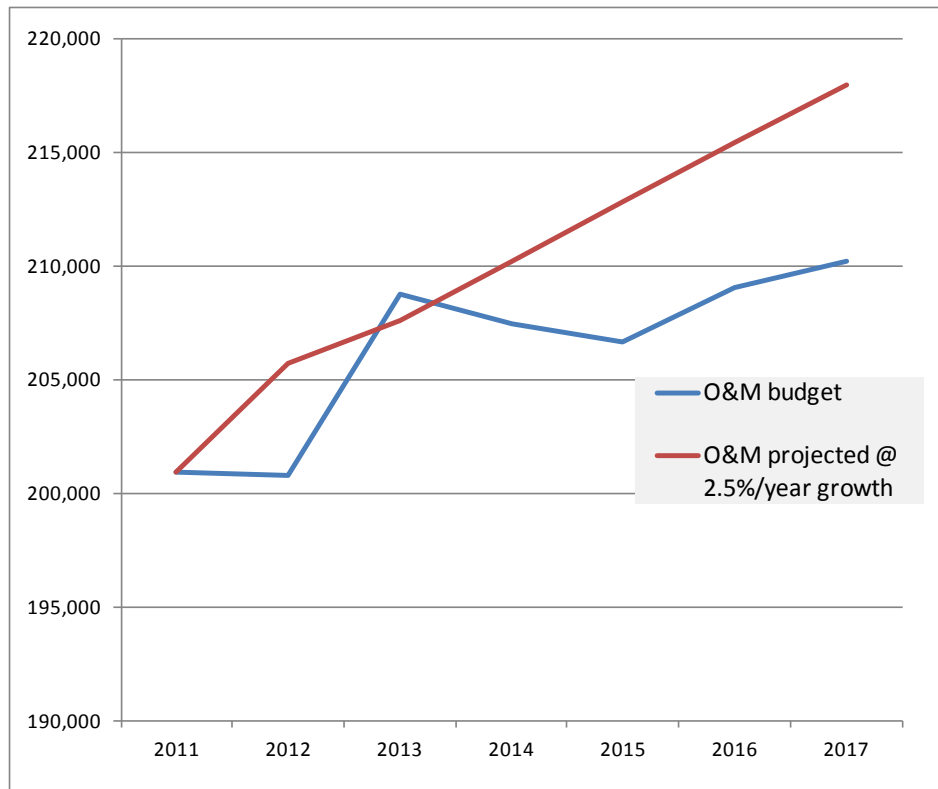


Figure C-8. Comparison of the DOD Past and Projected Base O&M Budgets with O&M Projected to Grow at the Historical Rate of 2.5 Percent per Year

Figure C-9 displays the total budget topline through FY2017, and compares it to a hypothetical profile based on the *historical trends* shown in Figure C-6. This hypothetical profile is an average of the two historical profiles (i.e., post-Vietnam war downturn, and post-cold war downturn). The two projections shown in Figure C-9 are quite similar, except that the profile in the budget drops less gradually and levels off earlier than the projection based on average historical trends.

Figure C-9 shows two projections of the DOD budget topline: (1) PB13 and (2) a profile following an average of post-Vietnam-war and post-cold war declines.

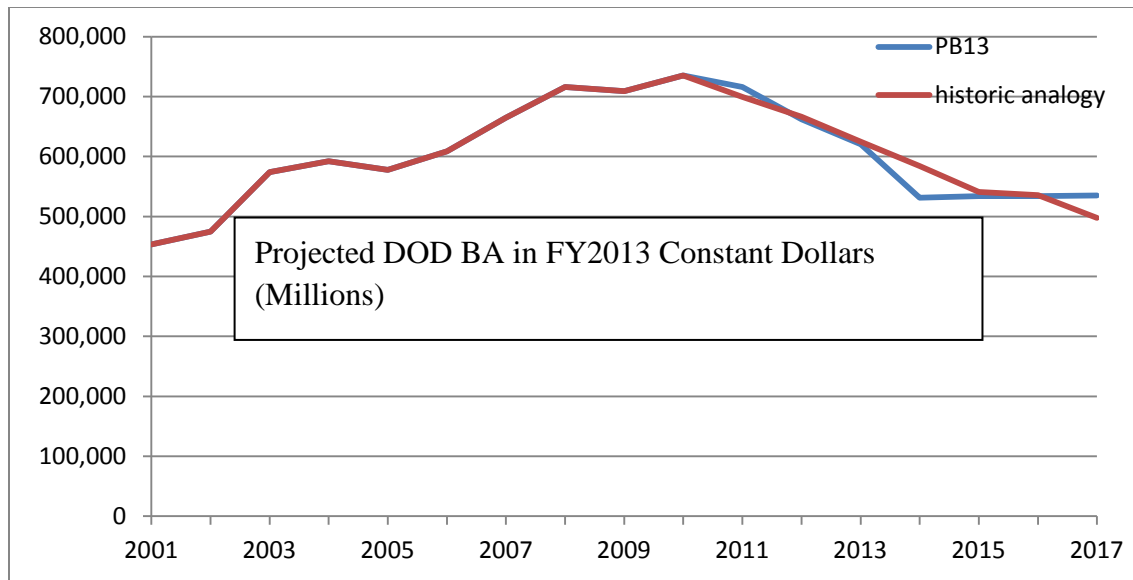


Figure C-9. Comparison of Past and Projected DOD Topline (Budget Authority) to Historical DOD Budget Drawdowns

Alternative Projections

Figure C-10 compares the funds budgeted for acquisition in PB13 with three other projections of funds available for acquisition.

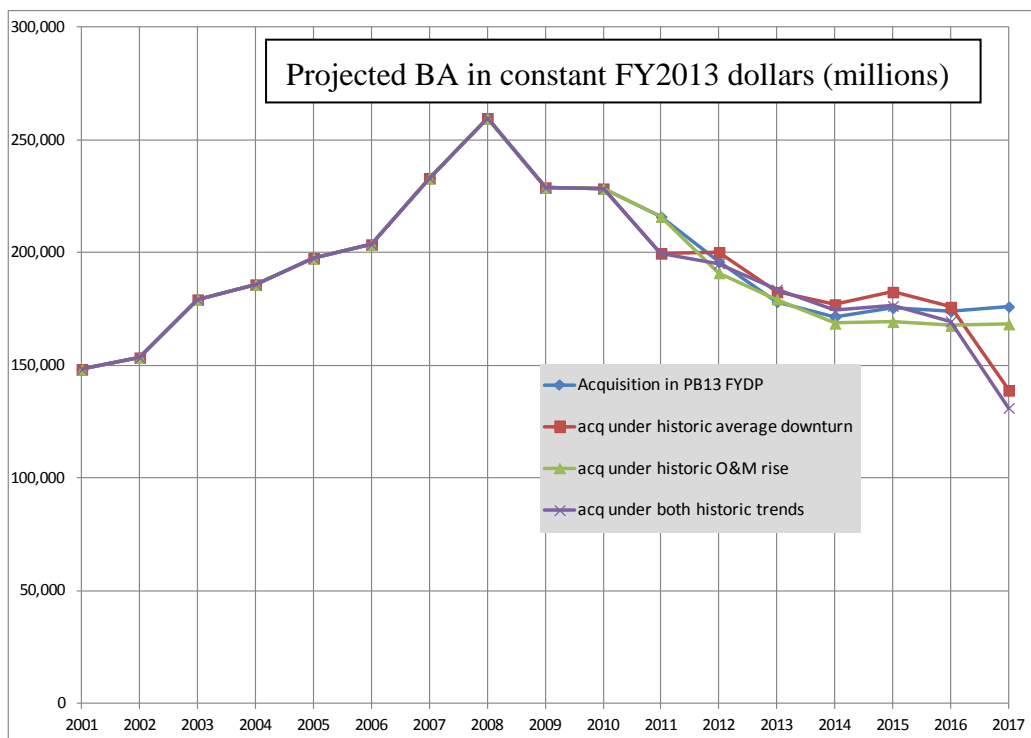


Figure C-10. Alternative Projections of Funds Available for Acquisition

The trend line for “acquisition under historic O&M rise” uses the PB13 FYDP acquisition total and reduces it by the difference between the PB13 FYDP O&M and the projection of O&M at 2.5 percent per year per active duty service member. As illustrated in Figure C-8 above, the PB13 FYDP O&M and O&M projected at historical rates of increase are fairly close through FY2017. The second alternative projection, “acquisition under historic average downturn,” adjusts the PB13 FYDP acquisition total by the difference between the PB13 FYDP topline and the topline as it would have been had it followed the “historic analogy” shown in Figure C-9. The third alternative projection assumes both historical trends.

All of these are in good agreement through FY2016, and in reasonable agreement until FY2017. The basic reasons for this are: (1) as illustrated, the budgeted total topline is reasonably consistent with historic downturn profiles until about FY2016; (2) the decline in end-strength through FY2017 acts to offset increases in O&M per active service member. Were the topline to follow the historic pattern, it would continue to decline through FY2017—and continue dropping through about FY2020—rather than becoming flat after FY2013.

The basic approach used by DOD—absorbing the topline downturn through the elimination of OCO, and reducing end-strength to avoid increases in O&M and MILPERS—is successful in protecting acquisition through FY2017. However, extending these projections further suggests problems that develop rapidly soon after. If after FY2017 the topline downturn continues as history suggests—rather than remaining flat—and MILPERS and O&M rise because end-strength no longer declines, there would be considerable downward pressure on funds for acquisition. This is illustrated in Figure C-11, which extends three of the cases shown in Figure C-10 through FY2020. The first case, “flat topline and O&M,” continues the PB13 FYDP trends, i.e., both topline and O&M remain constant in constant dollars. DOD has not stated that these FYDP trends should be expected to continue beyond FY2017; this case illustrates the implications for acquisition should one make that assumption. The second case, shown in Figure C-11, “historic profile topline, O&M flat” extends the Figure C-10 case “acquisition under historic average downturn.” In this case, the topline is assumed to follow the average of the post-Vietnam and post-Cold-War topline declines, while O&M is assumed to remain constant in constant dollars. O&M could be kept constant through further reductions in end-strength, through the successful implementation of measures that arrest the long-term rise in O&M per active duty service member, or by some combination of these two approaches. The third case assumes both the historical trend in the topline, and the continued rise in O&M per active duty service member at 2.5 percent per year.¹⁸

¹⁸ To prevent a distracting anomaly in the data, the large reduction in the FY2014 topline was smoothed for Figure C-10 and Figure C-11.

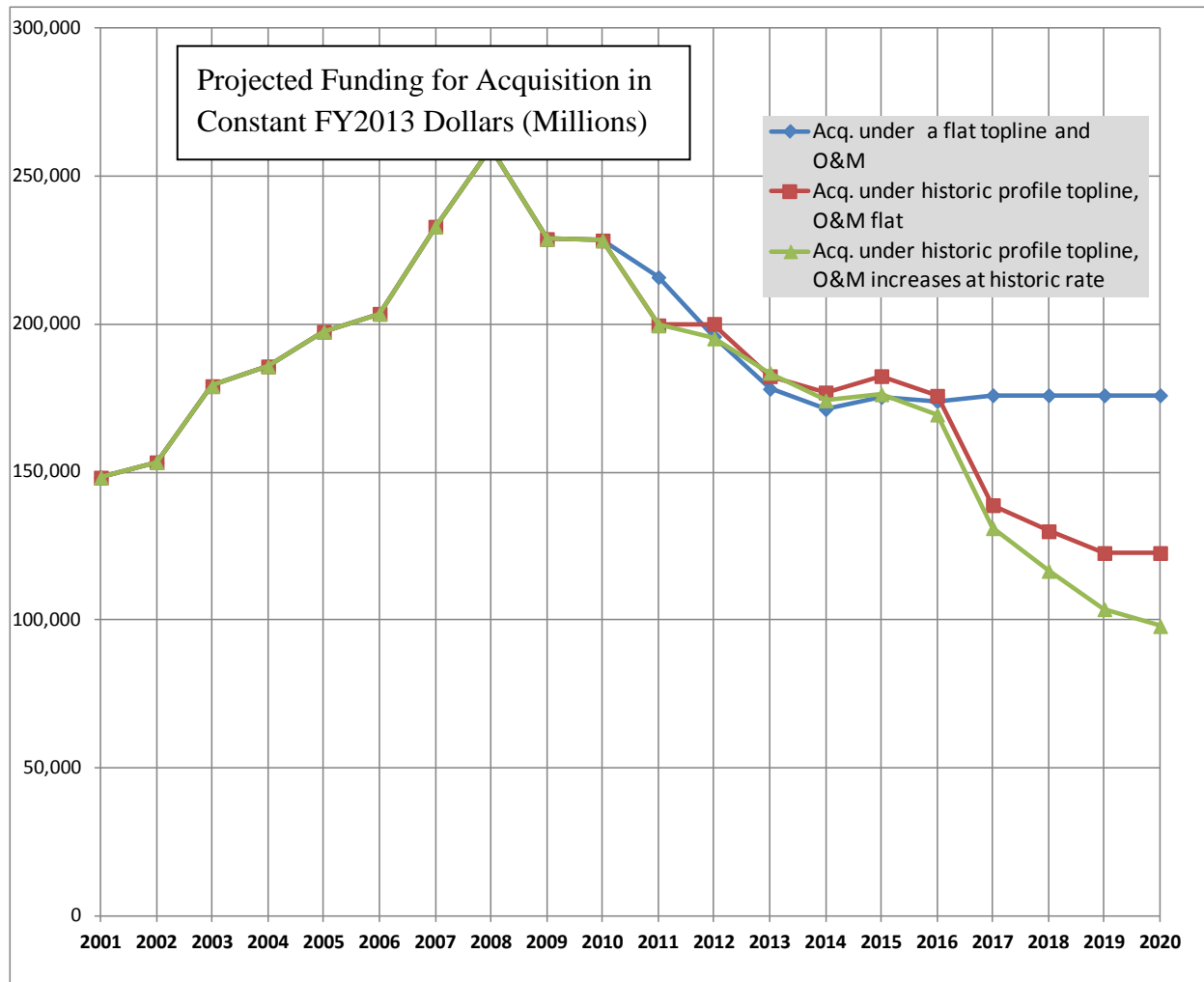


Figure C-11. Three Alternative Projections of Funds Available for Acquisition through FY2020

It should be noted that the fractional decline in acquisition from FY2010 to FY2020 that results when both historic trends are assumed to continue is about the same as the fractional decline in acquisition from 1969 to 1979.

Figure C-12 projects the historical analogy through another decade, which by historical analogy is assumed to be a decade of recovery. This projection assumes:

- The topline profile follows the average of the post-Vietnam and post-cold wars through FY2020
- The topline recovery mirror-images the topline decline, returning in 2030 to the total (base budget plus OCO) topline of FY2010
- End-strength remains constant beginning in FY2017
- O&M per active duty service member continues its increase at 2.5 percent per year

- Beginning in FY2018, MILPERS per active duty service member resumes an increase of 1.5 percent per year

For the period FY2021–FY2030, funding for acquisition is calculated by beginning with the calculated FY2020 value (Figure C-11), adding the topline increase for each year, and subtracting the yearly increase in O&M and MILPERS.

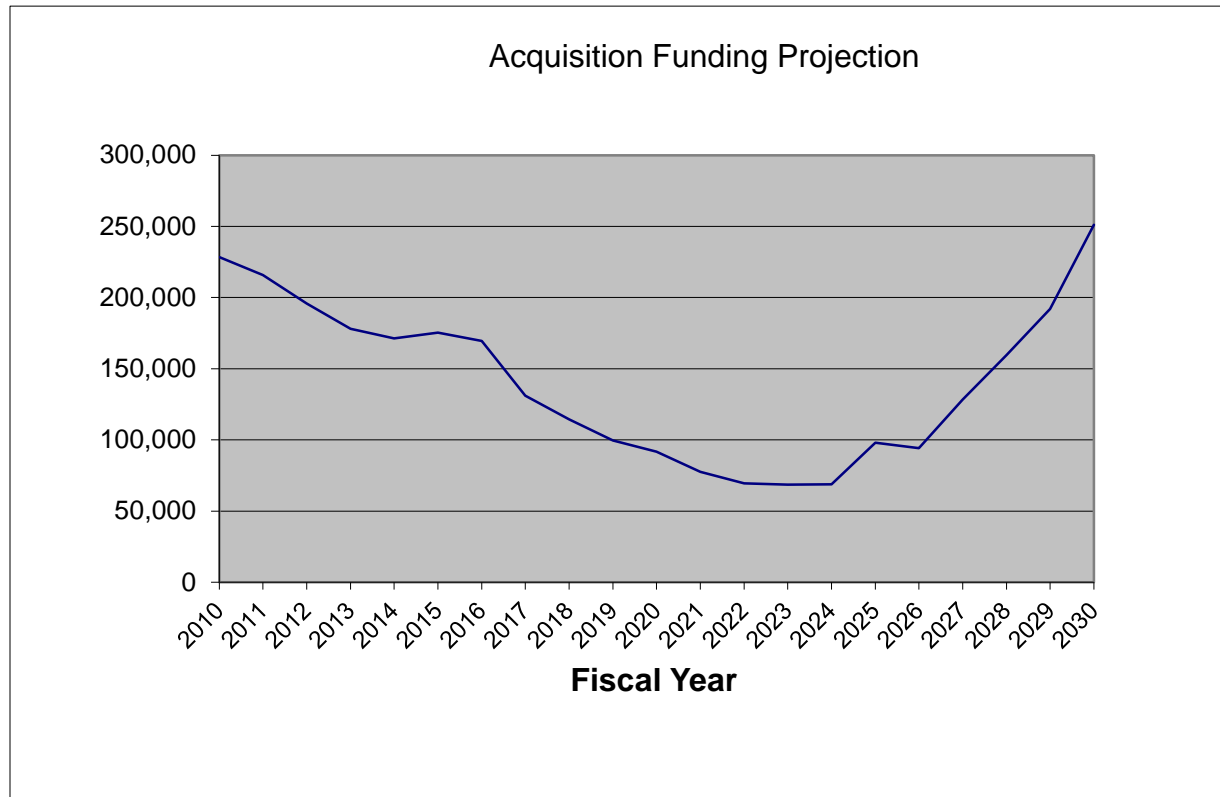


Figure C-12. Projected Funds Available for Acquisition in Constant FY2013 Dollars (Millions)

The projection for acquisition shown in Figure C-12 troughs at a 70 percent decline from its high in FY2010—a considerably larger percentage decline than the two historical analogs investigated. And the steep recovery beginning in FY2027 results from the assumption that the DOD topline will return to the war level of FY2010—in essence it postulates another event or political consensus in that timeframe that would justify such a ramp-up in defense spending.

This is obviously not great news for acquisition, but it is better than the projections presented in the 2009 IDA study. The difference between this projection and the earlier projections is due, in large measure, to the decreases in end-strength that have been announced since the 2009 study was produced. The pattern seems clear enough. Not counting demobilization from World War II, this will be the third major downturn in the defense budget. In all three cases, the decreases are absorbed by a combination of reductions in end-strength (and subsequently, in force structure), and deep cuts in acquisition spending. Without those reductions

in end-strength and force structure, the impact on acquisition would be far greater. When the budget increases, the reductions in acquisition are recovered. Funding for O&M and MILPERS also recover, but these increases are absorbed by continuing increases in O&S costs per active duty service member, and losses in end-strength and force structure are generally not recovered.

As a result, each of these cycles has had two basic consequences: (1) a reduction in end-strength and force structure; and (2) a severe disruption of defense procurement through forcing cycles of “boom and bust.” In previous cycles, a restructuring of the defense industrial base has resulted. Large reductions in spending greatly complicate the ability to maintain development and production capacities.

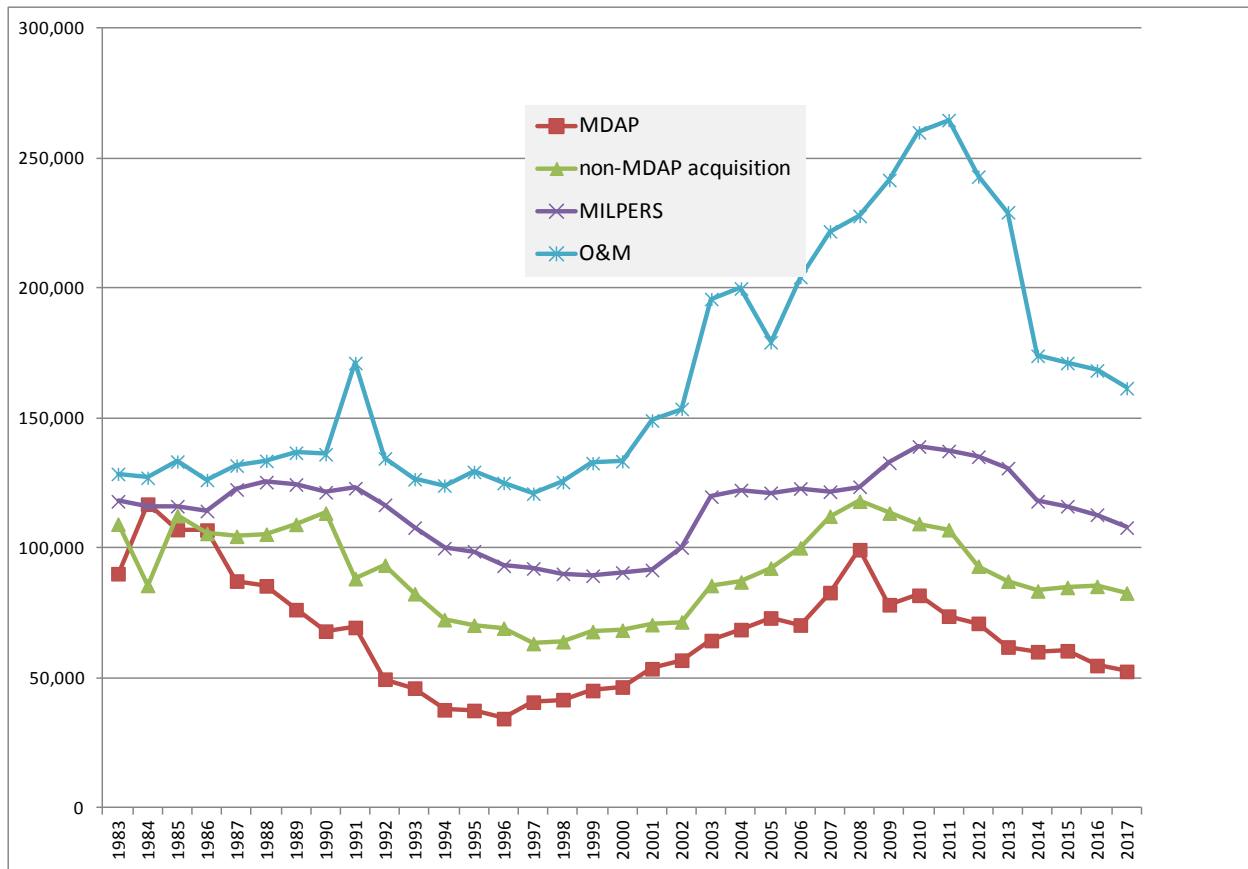
Each of these cycles of downturn and recovery has set the stage for the next one. If escalating rates of MILPERS and O&M are not brought under control, the next downturn—should there be one—will again be absorbed by permanent reductions in end-strength and about a decade of austerity in acquisition.

The possible effects of enforced austerity in acquisition will be discussed in the next section.

Projecting Major Defense Acquisition Program (MDAP) and Non-MDAP Acquisition Spending

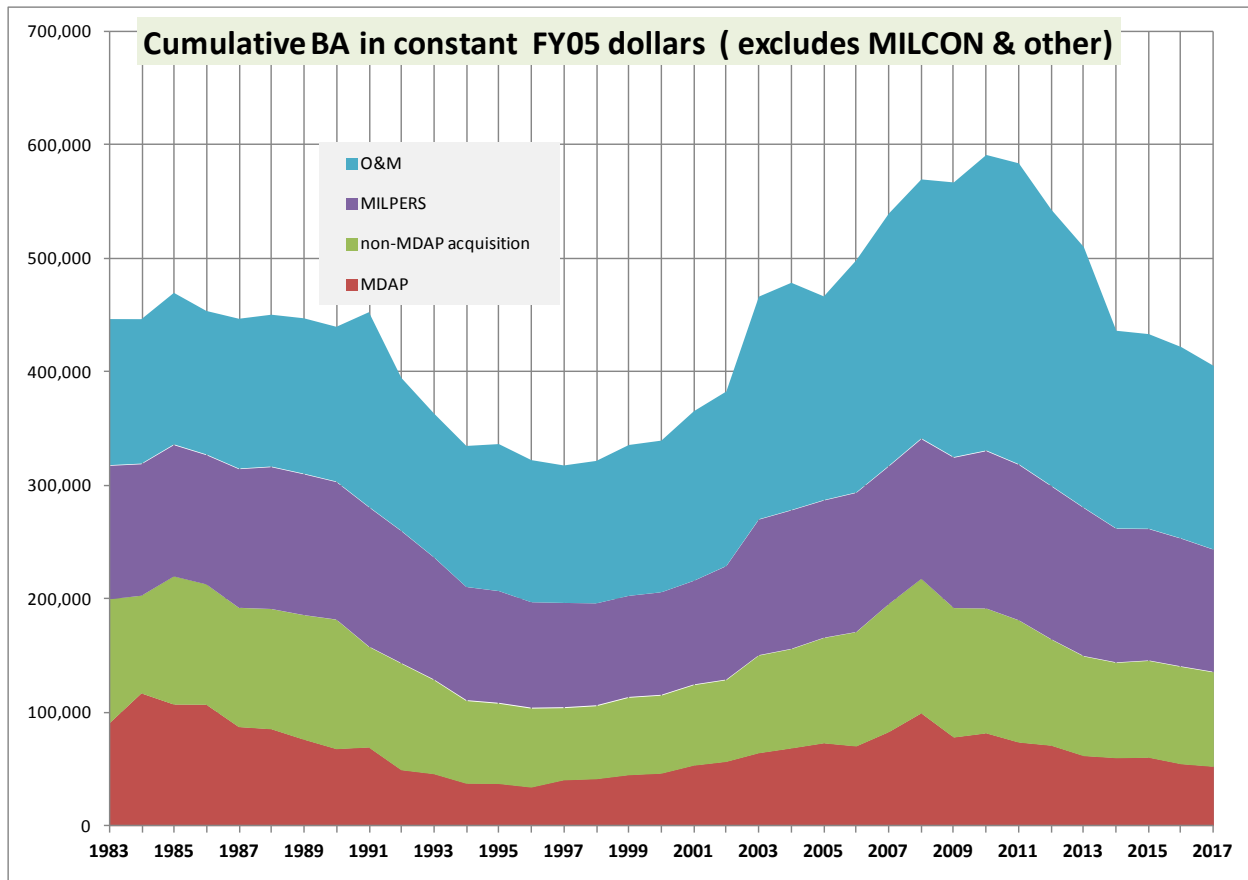
Acquisition spending can be separated into spending for MDAPs and spending for all other acquisition programs (also referred to as *non-MDAP acquisition* or *other investments*), as seen in Figure C-13, Figure C-14, and Figure C-15. Figure C-13 shows funding lines for each budget account, while Figure C-14 shows the same data as an area chart, with the funding “stacked.” Figure C-15 shows historical and projected MDAP funding as a percentage of acquisition funding. The history of, and near-term projections for, MDAP spending were extracted from two sources: the Selected Acquisition Report Summary Tables¹⁹ prior to 1997 and the DOD Defense Acquisition Management Information Retrieval (DAMIR) system, which is a repository of all SARs published since 1997. The difference between the extracted annual MDAP totals and the acquisition total in PB13 is “non-MDAP acquisition.” The broad peak in MDAP spending during the 1980s corresponds with the defense buildup of that period. Similarly, there is a broad peak in non-MDAP spending corresponding to prolonged operations in Iraq and Afghanistan, and a narrow peak in MDAP spending also related to Iraq and Afghanistan. Excluding those peaks in funding, the ratio of MDAP to total acquisition has been reasonably consistent over thirty years, as shown in Figure C-15.

¹⁹ The SAR Summary Tables reflect funds *requested* for each MDAP in the budget year, so they are not what was actually spent. Nonetheless, they are the best pre-1997 historical data available. Comparisons of the SAR Summary Tables and the DAMIR data post-1996 indicate significant differences, many of which reflect program increases in response to the needs of ongoing operations. At the aggregate level, for the purposes of this paper, the inconsistency between the pre-and post-1997 MDAP data is not consequential. These figures are in constant FY2005 dollars, in keeping with the historical tables in the President’s Budget (PB13).



Note: Displayed as separate lines

Figure C-13. Funding for MDAP Acquisition, Non-MDAP Acquisition, MILPERS, and O&M, FY1983–FY2017 in Constant FY2005 Dollars (Millions)



Note: Displayed as area chart

Figure C-14. Funding for MDAP Acquisition, Non-MDAP Acquisition, MILPERS, and O&M FY1983–FY2017 in Constant FY2005 Dollars (Millions)

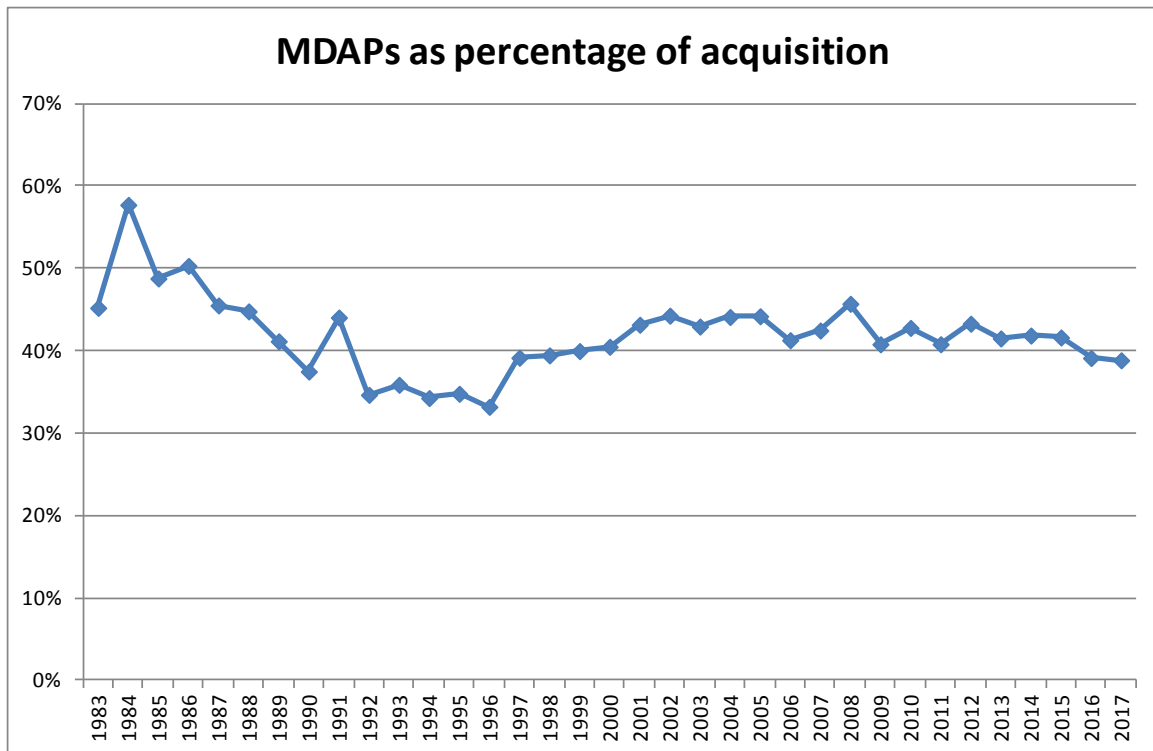


Figure C-15. MDAP Acquisition as a Fraction of Total Acquisition, FY1983–FY2017

Figure C-16 provides a more detailed breakdown of funding history and projections for MDAPs and other acquisition investments. The figure displays selected data for four periods during the interval FY1997–FY2030: (1) historical (actual) through FY2011; (2) estimated for FY2012 and requested for FY2013 (PB13); (3) projected by DOD through the PB13 FYDP; and (4) projected by IDA for FY2018 through FY2030. All information on MDAP funding comes from the SARs,²⁰ and the figure assumes that all current MDAPs will continue as planned. Although it is recognized that existing pre-MDAPs²¹ and new starts not yet in the DOD acquisition process will become MDAPs within the timeframe of this analysis, the figure does not contain any of those programs and programs to be.

Figure C-16 shows BA in constant FY2013 dollars. (If comparing Figure C-16 and Figure C-13 and Figure C-14, note that Figure C-16 is in constant FY2013 dollars, while Figure C-13 and Figure C-14 are in constant FY2005 dollars.) Funding for the largest MDAPs is shown individually, as indicated in the legend. All other MDAP funding is aggregated as “other MDAPs.” All other acquisition spending is shown aggregated as “other investments.” “Other investment” beyond FY2017 is projected at the same annual level as FY2017 (in constant

²⁰ These data are actual (FY 2012 and prior) and projected (post-2012) program expenditures—not budget requests.

²¹ These are existing acquisition programs that are still in technology development that will become MDAPs once they pass Milestone B.

dollars). This projection is reasonable (though by no means certain) under the assumption that active duty end-strength, as a rough proxy for force structure, remains constant beginning in FY2017.²² Figure C-16, therefore, projects funding requirements under two basic assumptions: (1) current MDAPs will be completed as planned; (2) “other investments” will remain at a constant level FY2017–FY2030. Since no new programs are being added to the MDAP category, funding for the current set of MDAPs begins to decline starting in FY2019.

The figure also explores the implications for this portfolio of investments of each of three alternative projections of funding available for acquisition. The first projection, labeled “flat acquisition,” assumes that funding available for acquisition will remain constant in constant dollars in FY2017–FY2030. This projection indicates a clear “wedge” of funding available for new MDAPs in the period FY2020–FY2030.²³

The second projection, “flat topline,” assumes that the defense topline remains constant in constant dollars FY2017–FY2030, but that both O&M per active duty service member and MILPERS per active duty service member continue to grow at historical rates with active duty end-strength remaining fixed at the planned FY2017 level. This projection can be seen to have almost immediate impact on funds for acquisition, modest at first but quickly becoming severe by the early FY2020s, theoretically wiping out all funding for acquisition by FY2026.

The third projection, “historic trends,” assumes that MILPERS and O&M increase as described for “flat topline,” but that the topline follows historical patterns,²⁴ continuing to decrease in FY2013–FY2020, and then recovering in FY2020–FY2030 to the FY2010 level (FY2010 base plus OCO) in constant dollars. This projection creates a deep acquisition “bathtub” that would reduce acquisition funding by more than 60 percent from the FY2017 level by FY2022, which would have very severe implications for DOD acquisition and the force structure it supports. However, in this case, funding for acquisition increases rapidly in FY2025–FY2030 (premised on the assumption that the FY2010 DOD topline level—including OCO—will be reached again in constant dollars in that time period).

While the “flat topline” projection is, at face value, fairly hopeless for the long haul, the “historic trends” presents a challenging situation, which, based on historical analogy, would be

²² “Other investment” includes smaller acquisition programs, Science and Technology (S&T) programs, and classified programs (including national intelligence and other classified programs). The first category can be assumed to vary roughly with force structure, whereas the latter two in aggregate track historically as near constant percentages of the DOD topline.

²³ Numerous claims on these hypothetical funds are known to exist, such as a new manned bomber already announced by the White House. Also there is a large inventory of aging aircraft, ships, helicopters and combat vehicles that will require replacement (or at least service-life extension programs) in that timeframe.

²⁴ This is an average of post-Vietnam and post-cold-war drawdown experience.

potentially manageable—a judgment supported by the fact that similar situations have been managed twice since the Vietnam war.²⁵

The severe conditions projected for both “flat topline” and “historic trends” are driven largely by projected growth in MILPERS and O&M. Bringing these appropriations under better control could go a long way toward alleviating these projected conditions. Further cuts in active duty end-strength could help accomplish that end, but may not be consistent with national security demands. However, cuts in force structure (and thus end-strength) have been the solution for more than half a century.

²⁵ Shaw, Porter, and Tapparo, *Implications* provides some thoughts on how such management might be accomplished.

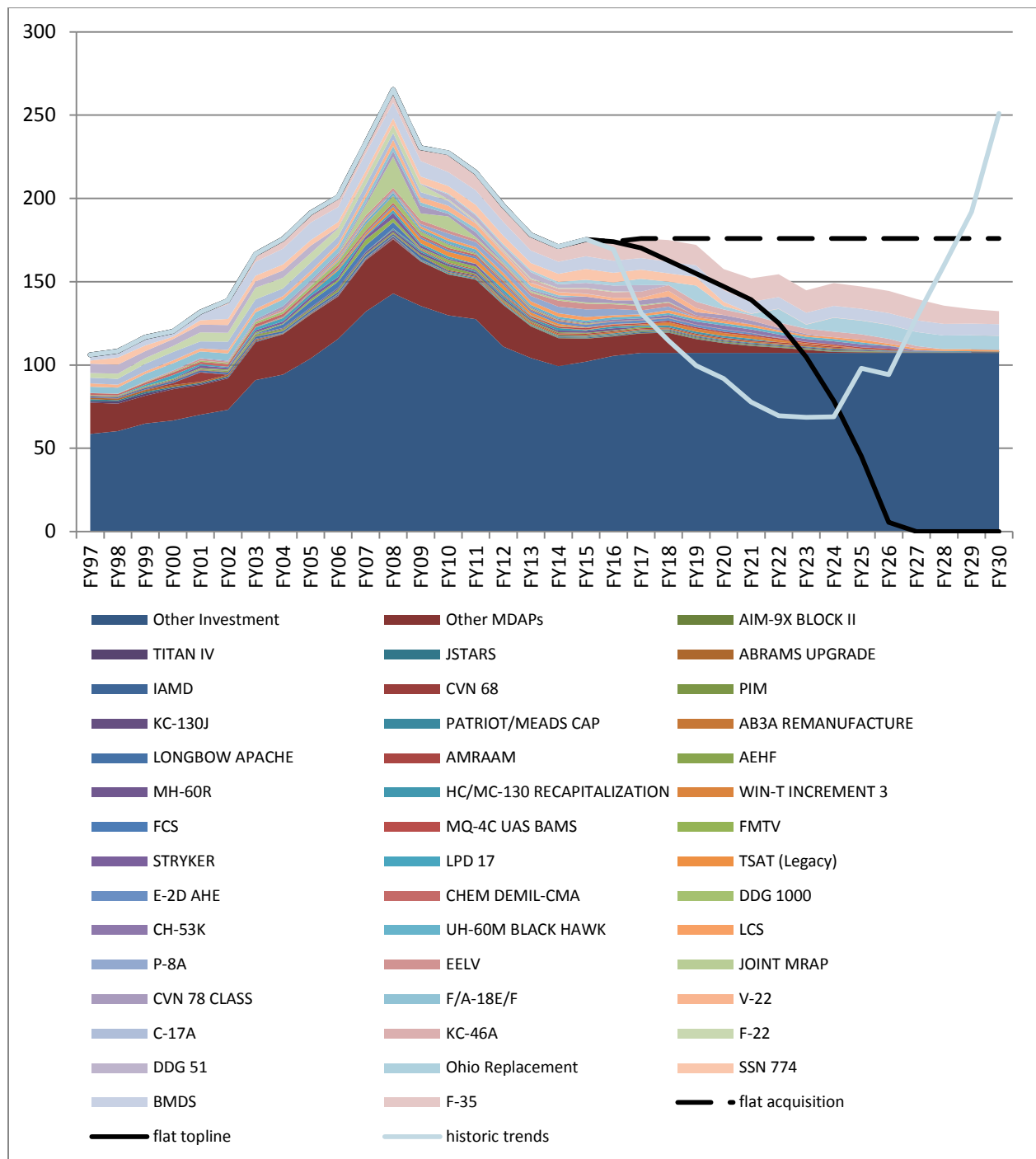


Figure C-16. Projections of MDAPs and Other Acquisition Funding

Observations/Findings

The defense budget—and funding available for acquisition—is almost certainly entering another period of significant decline.

The re-election of President Obama provides a reasonable level of confidence that PB13 (including the FYDP) is a credible blueprint for the defense budget FY2013–FY2017, at least in the absence of the sequestration required by the Budget Control Act of 2011.²⁶ The defense budget is almost certainly entering yet another period of downturn. Unlike the two previous downturns that occurred twenty years ago and forty years ago, this downturn is established and charted in the President’s Budget, and supported by DOD analysis and accounting. This appendix has demonstrated that the PB13 FYDP displays patterns that are generally consistent with these previous downturns.

The modest rate of recovery from the “great recession” underscores the expectation that there will be no dramatic economic changes that will make the defense budget downturn avoidable. Furthermore, the Nation has chosen this same period to address the federal deficit and national debt issues that have been building since 1981, and is focusing on solutions that include large reductions in discretionary federal spending.

The mid- to long-term profile of that decline—and subsequent recovery—can only be the subject of informed speculation.

One notable feature of PB13 is that after a large initial downturn, the topline and the three major accounts (MILPERS, O&M, and acquisition) are each essentially flat (in constant dollars) for FY2014–FY2017. The basic reasons behind this seem quite clear: (1) an assumption that Congress will authorize and appropriate sufficient funds to keep the topline constant over this period; and (2) an assumption that MILPERS and O&M funding can be kept to zero real growth. These assumptions imply that a constant amount of funding will be available for acquisition. This study has not investigated the likelihood that the first two assumptions can become a reality.

Like those previous downturns, this one will be primarily absorbed by cutting active duty end-strength and by reductions in acquisition spending. A major issue is how much acquisition spending will decline, and how that decline will be distributed over the coming years. History can help guide expectations, but obviously provides no certainty as to what the future will actually bring.

PB13 and supporting materials indicate that, in addition to cutting end-strength, the growth of MILPERS and O&M per active duty service member will be held well below their long-term historical rates of increase through FY2016. However, those documents provide no direct insights into how that is to be accomplished and, more importantly, how it can be continued for the longer term.

²⁶ As this paper was in final preparation, sequestration, in fact, went into effect. This appendix does not reflect any of the potentially significant implications of that somewhat unexpected development.

This appendix postulated three projections of funds available for acquisition through FY2030:

1. Flat acquisition spending in constant dollars FY2014–FY2030. This is a simple extrapolation of PB13 acquisition spending.
2. The topline is maintained at the FY2017 level (in constant dollars) through FY2030, while the costs of MILPERS and O&M per active duty service member resume their historical rates of increase.
3. Historical trends in topline, MILPERS, and O&M are followed FY2016–FY2030.

How acquisition is conducted over the next two decades will depend heavily—but not solely—on the budgetary profile.

Of these three postulated profiles, the first—continued flat acquisition spending at FYDP levels—provides the best outcome for acquisition. It provides the most total funding over the period, and the highest yearly funding through FY2028. Since it is both stable and predictable, it provides the best environment for effective planning and efficient use of capacities for manufacturing and research and development. In addition to continued constant non-MDAP procurements, it provides \$70–80 billion for MDAPs, which, while somewhat short of MDAP peaks in FY2008 and the mid-1980s, exceeds MDAP spending for most years over the past three decades.

Simply maintaining a flat topline while O&M and MILPERS continue to grow at historical rates would produce a disaster for acquisition, forcing acquisition funding to zero in about fifteen years. This is clearly an untenable profile, which doesn't provide a useful basis for acquisition planning and analysis. However, the point of considering it at all is to note that it results from plausible conditions and, therefore, provides an alert that steps need to be developed and taken to ensure that it does not come to pass.

A cycle of topline downturn and recovery that mimics the previous two cycles could restore acquisition funding to historical peak levels by approximately 2029, but would produce deep problems in acquisition for about twelve years. This would almost certainly force the cancellation of many current MDAPs well before their planned completion, preclude the start of new MDAPs before about 2027, and cut deep into non-MDAP spending for several years. *The implications of such a spending profile for the defense industry, RDT&E providers, and for meeting the modernization needs of U.S. forces need serious analysis.*

Table C-1. DOD Total Obligational Authority—Fiscal Year FY2013 President's Budget

FY2013 Constant Dollars in Millions							
	FY 2011	FY 2012	FY2013	FY2014	FY2015	FY2016	FY2017
MILPERS	159,251	155,916	149,172	133,964	134,509	135,133	135,658
O&M	314,921	288,793	273,297	207,579	207,217	209,701	210,527
Procurement	136,054	124,300	108,511	102,464	108,382	110,320	114,439
RDT&E	78,556	73,943	69,653	68,630	66,930	63,587	61,539
Military Construction	17,604	12,388	9,572	10,065	10,644	8,876	7,456
Family Housing	3,537	1,893	1,856	1,553	1,462	1,524	1,532
Revolving & Mgmt Funds	3,270	3,127	2,628	1,404	745	1,532	640
Grand Total DOD	713,193	660,360	614,689	525,659	529,889	530,673	531,791
Acquisition Total	214,610	198,243	178,164	171,094	175,312	173,907	175,978
Year-To-Year Delta \$							
MILPERS		-3,335	-6,744	-15,208	545	624	525
O&M		-26,128	-15,496	-65,718	-362	2,484	826
Procurement		-11,754	-15,789	-6,047	5,918	1,938	4,119
RDT&E		-4,613	-4,290	-1,023	-1,700	-3,343	-2,048
Military Construction		-5,216	-2,816	493	579	-1,768	-1,420
Family Housing		-1,644	-37	-303	-91	62	8
Revolving & Mgmt Funds		-143	-499	-1,224	-659	787	-892
Total		-52,833	-45,671	-89,030	4,230	784	1,118
Acquisition Total		-16,367	-20,079	-7,070	4,218	-1,405	2,071
Year-To-Year Delta Percents							
MILPERS		-2.1%	-4.3%	-10.2%	0.4%	0.5%	0.4%
O&M		-8.3%	-5.4%	-24.0%	-0.2%	1.2%	0.4%
Procurement		-8.6%	-12.7%	-5.6%	5.8%	1.8%	3.7%
RDT&E		-5.9%	-5.8%	-1.5%	-2.5%	-5.0%	-3.2%
Military Construction		-29.6%	-22.7%	5.2%	5.8%	-16.6%	16.0%
Family Housing		-46.5%	-2.0%	-16.3%	-5.9%	4.2%	0.5%
Revolving & Mgmt Funds		-4.4%	-16.0%	-46.6%	-46.9%	105.6%	-58.2%
Total		-7.4%	-6.9%	-14.5%	0.8%	0.1%	0.2%
Acquisition Total		-7.6%	-10.1%	-4.0%	2.5%	-0.8%	1.2%

Note: MILPERS = Military Personnel; O&M = Operation and Maintenance; RDT&E = Research, Development, Test and Evaluation.

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Appendix F

Abbreviations

AAAV	Advanced Amphibious Assault Vehicle
AMPV	Armored Multi-Purpose Vehicle
ASD	Assistant Secretary of Defense
AT&L	Acquisition Technology and Logistics
BBP	Better Buying Power
BFV	Bradley Fighting Vehicle
BMDS	Ballistic Missile Defense System
CAIV	Cost as an Independent Variable
CBO	Congressional Budget Office
CCMD	Combatant Command
CD&I	Combat Development and Integration
CFLI	Core Function Lead Integrator
CNO	Chief of Naval Operations
COCOM	Combatant Command Authority
DAMIR	Defense Acquisition Management Information System
DCAPE	Director, Cost Assessment and Program Evaluation
DCGS-A	Distributed Common Ground Station–Army
DMC	Defense Mission Category
DOD	Department of Defense
DPP	Defense Program Projection
DTC	Design to Cost
EPA	Extended Planning Annex
EPATOA	Extending Planning Annex Total Obligational Authority
ETT	Enhanced Tradespace Tool
FCS	Future Combat System
FY	Fiscal Year
FYDP	Future Years Defense Program

GCV	Ground Combat Vehicle
GEF	Guidance for the Employment of the Force
GWOT	Global War on Terrorism
JAGM	Joint Air-to-Ground Missile
JLTV	Joint Light Tactical Vehicle
JTRS	Joint Tactical Radio System
MDD	Materiel Development Decision
MDAP	Major Defense Acquisition Program
MILCON	Military Construction
MILPERS	Military Personnel
MSE	Patriot PAC-3 Missile Segment Enhancement
O&M	Operation and Maintenance
O&S	Operating and Support
OASD(FM&P)	Office of the Assistant Secretary of Defense (Force Management and Personnel)
OASD(SOLIC)	Office of the Assistant Secretary of Defense (Special Operations/Low Intensity Conflict)
OCO	Overseas Contingency Operation
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OUSD(A)	Office of the Under Secretary of Defense for Acquisition
OUSD(P)	Office of the Under Secretary of Defense for Policy
P&R	Programs and Resources
PA&E	Program Analysis and Evaluation
PEB	Program Evaluation Board
PEG	Program Evaluation Group
PIM	Paladin Integrated Management
POM	Program Objective Memorandum
PPBS	Planning, Programming and Budgeting System
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
SAF/AQ	Office of the Secretary of the Air Force for Acquisition
SAR	Selected Acquisition Report
SBIRS	Space-Based Infrared System

SBL	Space-Based Laser
SECDEF	Secretary of Defense
SLEP	Service-Life Extension Program
SOCOM	Special Operations Command
TOA	Total Obligational Authority
USAF	United States Air Force
USD(AT&L)	Under Secretary of Defense for Acquisition Technology and Logistics
USMC	United States Marine Corps
WIN-T	Warfighter Information Network—Tactical
WIPEB	Warfighting Investment Program Evaluation Board

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